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THE
JOURNAL OF APPLIED PSYCHOLOGY

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THE ABILITIES OF AN EXPERT MARKSMAN TESTED IN THE PSYCHOLOGICAL LABORATORY

ARTHUR I. GATES, Teachers College, Columbia University

The current interest and activity of psychologists in devising and applying tests of special fitness for various vocations required in military operations, may justify a report upon an examination in the psychological laboratory of a man of expert ability as a marksman. Mr. William F. Blasse, of San Francisco, long known as an exceptional marksman, scored the world's record on the 200 yard range, free off-hand shooting, 100 shots consecutively, on September 22, 1916. Using the King Target, Mr. Blasse scored 223 points out of a possible 300 which would have required each of the 100 shots to have been placed within one and one-half inches of the center of the target. Some idea of the accuracy of Mr. Blasse's shooting is indicated by a detailed score; of the 100 shots, 38 scored red flags (within 1.5 inches from the center), 47 blue flags (3 inches from center) and 15 white flags (6 inches from center). The average distance of the 100 shots from center would be about 2.3 inches. Thus at a distance of 200 yards, shooting without a rest, Mr. Blasse would find a man's head an easy mark.

Taken into the University of California laboratory, Mr. Blasse gladly submitted to an experimental examination in an effort to determine in what respects his superiority over the marksmen of average or inferior ability was to be found. From many tests tried, only those which possess some special significance are mentioned. As a control group, 10 students in the laboratory consented to go through the same series of tests.

The group included 2 fair, 4 mediocre, 3 poor marksmen, and one who had shot a gun less than a half dozen times.

First of all it seems important that the expert marksman should have good eye-sight—but does he need to possess exceptional vision? A few stock tests demonstrated at once that while Mr. Blasse's eyes were efficient and without marked defects, they were not markedly above normal. In acuteness of vision, he was not unusual; color vision was normal; neither myopia, hypermetropia nor astigmatism of noticeable amount was present, and the general muscular control was normal. In short, his vision was good but not exceptional.

The second group of tests was concerned with the steadiness of motor control. Most of the tests employed are familiar to the psychological laboratory, and I shall economize space by omitting detailed descriptions of apparatus as well as details concerning the data.

The brass plate steadiness test described by Whipple,[1] with holes whose diameters were 32, 20, 16, 13, 11, 10, 9, 8, and 7 sixty-fourths of an inch, respectively, was first used. Holding the arm at full length, Mr. Blasse showed considerable superiority to the other 10 subjects, by holding the needle for 3 seconds in the hole of 13/64 inch diameter, while the steadiness of the other subjects failed in the next larger hole (16/64 inch), 6 others touched the sides of the 20/64 inch hole and one student failed in each of the 4 trials in the largest hole (1/2 inch). These relations held approximately for either hand, although the right hand was, on the whole, somewhat more steady.

For measures of the steadiness of one form of voluntary muscular control, the "tracing board" test[2] was employed. Several tests were made with the board placed at different angles, and in all these tests Mr. Blasse was somewhat, but not markedly, superior to the other subjects. The most steady student was quite as good.

The so-called "target test," designed to measure the accuracy and precision of movement[3] consisting in thrusting a pencil at a target placed at arm's length, showed that in this form of motor control, Mr. Blasse was only slightly superior to the average of ten students. The three tests just described, when considered together, show that the expert marksman is considerably superior in simple steadiness of motor control, but only slightly superior to the average in accuracy and pre-

[1] Manual of Physical and Mental Tests, 1910, p. 124.
[2] Whipple, *op. cit.*, p. 120.
[3] Whipple, p. 115ff.

cision of arm movements. In a final test (the tapping test) which measures mere speed of motor control, Mr. Blasse showed approximately average ability.

Not only is the steadiness of the arm involved in holding a gun, but the steadiness of the body as a whole. To measure this form of motor control a simple apparatus was used. A helmet was placed upon the head, projecting upward from the top of which was a stiff pointer. A smooth platform, like that of a punching bag, over which was stretched a paper covered with a thin layer of smoke, was adjusted so that it came into contact with the top of the pointer. The subject then attempted to stand motionless, every slight sway of the body being recorded by the tracings of the pointer on the smoked surface. Mr. Blasse showed some superiority in this test, his bodily movements being less marked than those of the steadiest students. The accompanying tracings (Fig. I) show the actual movements made by Mr. Blasse, a student of average, and one of marked unsteadiness. An interesting feature brought out by this test was that Mr. Blasse was subject to distraction or suggestion with regard to movements to a much less extent than were most of the other subjects. If I told certain subjects that they were swaying forward, efforts to counteract this imaginary movement would usually result in greater unsteadiness. If I told them to think hard of something to their left, as a rule the body would sway in that direction. A sudden slap of a book on a table usually provoked a series of movements and, most significant of all, if the subject thought intently upon the possibility of his increasing unsteadiness—if such ideas as: "I'm awfully unsteady to-day," "There, I moved again," "I can't seem to control myself," were dwelt upon, the results were disastrous. Now, Mr. Blasse was relatively cool and unmoved during all such procedures, although the general surroundings, the apparatus and so on were less familiar to him than to the other subjects, and although a certain fear lurked in his mind that he was not going to do well in these strange tests. The fact that Mr. Blasse was relatively non-susceptible to motor suggestibility is important.

Thus we have found that the expert marksman is possessed of superior steadiness of muscular control in the various stock tests. Finally, a test of the steadiness of the gun itself, which would result from various movements in combination, were measured. For one method, a steel needle was fastened to the end of the gun and the movements were recorded by means of the metal plate of small holes mentioned before. In this test, with the gun in hand, Mr. Blasse's superiority was more pro-

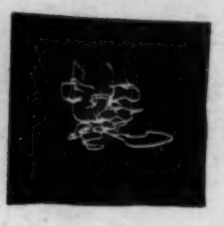
FIG. I

a.

b.

a, b. Tracings made by Mr. Blasse in the "overhead register" steadiness test.

c.

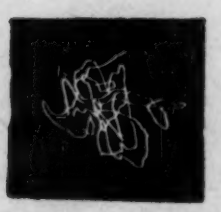


d.

c, d. Very good tracings made by other subjects in the "overhead register" test.

e.

f.



g.

e, f, g. Tracings made by subjects under suggestion. (e) suggestion of moving to right, (f) of moving to left and (g) of being "awfully shaky."

nounced than before. He was able to keep the pointer in a hole of 13/64 inch diameter for several seconds without touching, while most of the other subjects incessantly bumped the sides of a hole twice as large.

A more realistic test consisted in arranging a pointer which played against a smoked surface two inches below the end of the barrel while the subject aimed at a target and discharged a blank cartridge in the same manner employed in actual shooting. The accompanying records (Fig. II) tell the story better than words. It will be noted that the tracings made by Mr. Blasse's gun cover an exceedingly small range, that the sight is quickly obtained and that immediately after the discharge the gun is moved perpendicularly upward with a quick pull. The records for the other subjects show a faltering over a large area, with wide excursions in all directions. As the gun wabbles about the subject attempts to pull the trigger when the bead happens to hit upon the bullseye, and in this effort he is doubtless often unsuccessful. The clean cut, upward withdrawal of the rifle after firing is seldom shown, sometimes because it does not occur and often because the subject permits the gun to be jerked backward from its original position upon firing. It should be remembered that an excursion of a small fraction of an inch shown on the tracing would mean a wide miss when projected to a field 200 yards distant. Some of the subjects would probably have done well to "hit the side of a barn."

Aside from general steadiness and control of the bodily muscles, the action of the fingers controlling the trigger may have some bearing upon the result. Mr. Blasse habitually uses a sensitive trigger and in his opinion the action of the forefinger muscles with the required delicacy and at the right moment is an essential factor in the success of the shot. An exact graphic record of the control of these muscles was obtained by a simple apparatus. Over the bowl of a so-called "thistle tube" is stretched a delicate rubber membrane and the outlet at the small end of the tube is connected with a tambour. With the hand resting comfortably, the subject was given several tasks to perform with his forefinger. First he was asked to tap the membrane many times in succession, each time with equal force (see Fig. III). In the figure, the height of the line gives a picture of the force exerted by each tap. It requires no special measurement to see Mr. Blasse possessed some superiority in this capacity.

Using the same apparatus, the subject was asked to press down with uniform pressure and speed upon the membrane,

FIG. II

a.

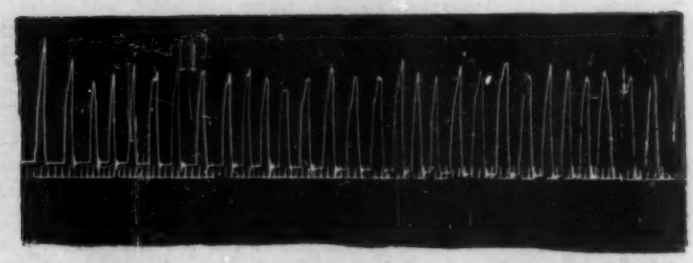
a. Records made by Mr. Blasse, showing the movements of the end of the rifle during aiming and firing. The straight vertical lines are made by the quick "pull away" of the rifle immediately after firing.

b.

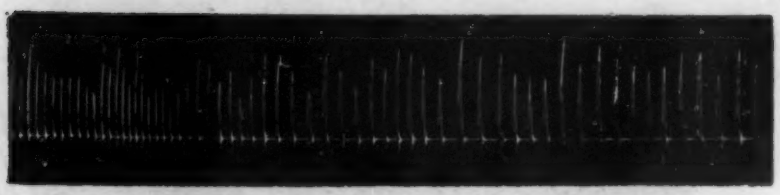
c. d.

b, c, d. Aiming and firing records made by other subjects. d. was made by a very good rifleman.

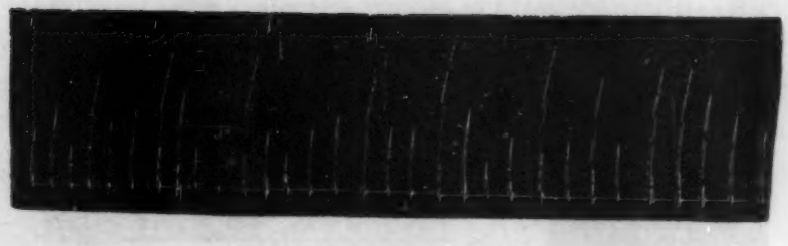
FIG. III



Record of Mr. Blasse attempting to tap the membrance of the thistle tube with uniform force. The height of the lines indicates the force of each stroke.



Record of an average subject in tapping.



Record of a very poor subject.

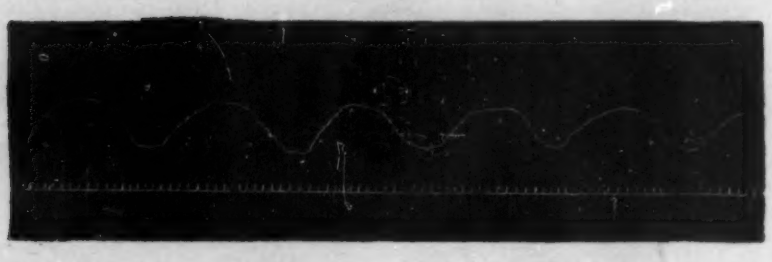
and then to release the pressure with equal speed. This test, which was repeated many times in succession, is a very trying test of muscular control. If speed and force remained constant throughout, a symmetrical curve would appear. The test was tried in several different positions, i.e., pressing downward perpendicularly, pressing it toward the left, pulling inward against it as one would in pulling a trigger. The curves illustrated here (Fig. IV), are for the latter task, and Mr. Blasse's superiority here is quite clear. The best record from the student subjects is not greatly inferior, however, and with practice this student might have developed to the marksman's equal in this respect. In general, however, Mr. Blasse not only greatly surpasses the ordinary person in steadiness of motor control, but also in the delicacy and precision of action with the trigger finger, which may, indeed, be of considerable significance.

The last group of experiments include certain tests in reaction time, the Hipp chronoscope being employed. All of the subjects were given preliminary practice, followed by 50 trials in each test. In single reactions to sound (telegraph key) Mr. Blasse showed an average of 119σ[4] as compared to an average of 124σ for 8 students, although three of these were superior to him. A similar test for a reaction to a sharp stroke of the left hand, gave an average time of 115σ for Mr. Blasse, and an average of 118σ for the 7subjects. Again three students responded more quickly in this test than did the marksman.

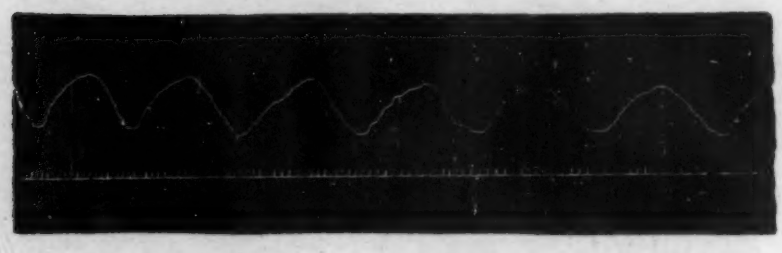
Another test, employing the same general apparatus, has more significance for the present purpose. An apparatus was provided such that the subject reacted by pulling a trigger in the same manner as employed in firing a gun. About 10 feet in front of the subject was placed the white end of a metal rod about a quarter of an inch in diameter which showed plainly on a black ground. Fastened to the end of a metal rod which was blackened so as to be almost invisible against the ground was placed another white piece of metal about 1/6 of an inch in diameter, which could be moved about in various ways and could at any time be brought into contact with the stationary spot of white first mentioned. When a contact was made between the two, the electric current was closed which set the chronoscope in action. The chronoscope was stopped when the subject pulled the trigger and thus the time between the coincidence of the spots and the pulling of the trigger was recorded. By moving the free spot of white all around the other, now approaching, now receding, now wavering here,

[4] σ equals a thousandth of a second.

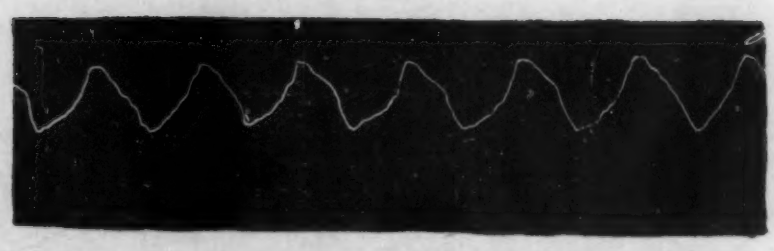
FIG. IV



Record of Mr. Blasse attempting to pull in and release the membrane of the thistle tube with uniform force.



The best record among the other subjects with the thistle tube as above.



One of the poorer records.

now there, before a contact was actually made, a situation similar to the bead of a rifle wavering about a target in actual shooting was secured. The speed and uniformity with which the trigger is pulled after the imitation sight coincides with the imitation target, gives a significant account of the coordination between eye and hand which would be of influence in shooting. If the trigger is pulled too quickly or too slowly, the bullet goes wide of its mark. What will be of special significance here is not only the speed of the reaction but its uniformity during a series of shots. If, for example, after the impulse to pull the trigger is initiated, the time elapsing before it is actually pulled is now 100σ, now 200σ, and at other times 150σ, 250σ or 90σ, it can readily be seen that the discharge will usually not occur at just the right time, since the gun is usually in motion. The impulse to pull, probably occurs just as, or just before, the bead begins a passage over the bullseye. But suppose the time elapsing between impulse and pull is always uniform, that is to say, for illustration, it is always 150σ or but a few sigma more or less. Since the interval is always about the same, the shooter comes through experience, through trial and success, to know just when to start the impulse to fire. He would then meet with success, even if his reaction time were fairly slow, although of course, the speedier the action the better.

The results from the reaction time tests are presented in briefest form by giving the average time with the mean variation, (this figure being the more significant) together with the number of premature reactions, or cases in which the subject reacted before the two white spots touched, i.e., before the signal was given. Fifty trials were given each subject in each test.

The following table gives the results for the irregularly moving test.

	Mr. Blasse	
Av. sigma	M. V.	Premature reactions
158	18	0
	Av. of 8 other subjects.	
198	96	6

Mr. Blasse's reactions are on the average much quicker, and very much more uniform, the M. V. of the others, on the average, being 5 times as great. Moreover, Mr. Blasse did not, in a single instance, "jump the gun," while the others did so on the average of one time out of 9 trials.

The following figures give the results of tests in which the

movable white spot instead of wavering about in an indefinite manner as above before finally touching the stationary spot, approached in one direction at a uniform speed.

Mr. Blasse—approaching from above downward.

Av.	M. V.	Premature reactions
155	10	0
	Approaching from below.	
162	13	0
	Approaching from right.	
152	9	0
	Approaching from left.	
150	10	0

Av. of from 8 to 10 other subjects.

	Approaching from above.	
Av.	M. V.	Premature reactions
142	48	7
	From below.	
179	66	4
	From right.	
145	48	6
	From left.	
159	52	5

In these tests, Mr. Blasse shows no superiority as regards speed of reaction, but this is due in large measure to the fact that many reactions of the other subjects followed upon premature impulses although the chronoscope was started before the reactions were completed, thus accounting for such impossible reaction times as 50σ etc., which cut down the average markedly. In many cases, as shown above, the impulse was initiated so early that the reaction was completed before "sight" and "bullseye" came into contact. In no case did Mr. Blasse make such a premature reaction. In fact the regularity of his responses is the most conspicuous superiority, and, as indicated earlier, this is a vital capacity in the development of marksmanship, since it offers the possibility (no matter what the actual time of reaction may be) of establishing a habit with regard to the moment of initiating the impulse to "pull" the trigger. So long as the reaction time is approximately the same, and the movements of the gun can be fairly well controlled, experience can readily supply the other requisite elements.

We may now summarize briefly the capacities which seem to characterize the champion marksman. His vision is not exceptional, although he has no special eye defects. It seems reasonable to suppose that for practical shooting, exceptionally keen eyes are not essential and even such eye defects as myopia, astigmatism and the like (which may be corrected by proper glasses) are not prohibitive of good marksmanship. Muscular difficulties of convergence which interfere with the movements of the two eyes together need not be a handicap since many expert marksmen shoot with one eye closed.

Muscular steadiness of the members of the body which are brought into action in holding the gun on its mark is of great importance. This was shown by all the tests that were employed. Of special import is the ability to resist the influence of various disturbing factors upon one's steadiness, such as slight distractions and especially subjective anxiety and auto-suggestion. The type of individual who is keenly aware of and disturbed by his own unsteadiness during shooting only increases his unsteadiness thereby. While muscular steadiness is doubtless not absolutely essential to skill in shooting, as evidenced by several good marksmen who are quite shaky, it certainly affords a great advantage.

A nicety of muscular control of the fingers involved in manipulating the trigger perhaps plays a rôle although this function should really be considered in connection with the results of the tests on reaction time. Our expert marksman showed a remarkably fine correlation of eye and hand in these tests. While nerved up, in such a test and likewise in actual shooting, to a high sensitivity, "breaks" in nervous control did not occur. The ordinary shooter, like the nervous athlete waiting the pistol, often "jumps the gun," that is, he pulls the trigger before the sight is perfect, or if he does not do this, he is unprepared when the proper moment comes, and the trigger is pulled too slowly. But our expert fails in neither of these respects. His reaction is never premature, and when bead and target are in the proper relation, the reaction is made with dispatch and always with great uniformity. This calm, speedy and uniform reaction is of utmost importance. Coupled with steadiness of general muscular control, this capacity seems to be essential to skill in marksmanship.

To what extent is the superiority of the expert in these tests due to training in shooting and to what extent is it due to native ability—ability possessed before practice,—is a matter of importance upon which our present data afford little evidence. If we pick out a hundred men at random—say, any hundred of

the men conscripted for government service—we would find that a few had received considerable, many a little and many no previous practice with a rifle. If we wished to select from these, a number who are destined after practice, to become the best sharpshooters, we must employ tests that divulge native, and not acquired ability. It must be admitted that much more work must be done with these and other tests before this matter can be decided with certainty. It will be necessary to test individuals who have had much experience in shooting but have developed but little skill. If our tests are valid for this purpose, such individuals would do poorly in them. It may be stated, at least, that of the 10 subjects beside Mr. Blasse who went through the tests, one whose experience in shooting was considerable was among the poorest in the tests, while one who was the best in most of the tests had shot a gun less than a dozen times during his life.

It would be interesting to know, also, what influence various habits of life have upon the capacities required for marksmanship. It might be said in passing that Mr. Blasse is a man of good habits. He has never indulged in smoking or drinking. With regard to smoking, data obtained in these tests from one rather heavy smoker are interesting. In the steadiness tests he was poorer than any of the other subjects and his shakiness was particularly noticeable just after smoking a cigarette. If permitted to wait for 12 or 15 minutes, his steadiness returned to his norm, however. This single record cannot be taken to prove that smoking makes one decidedly unsteady, for many other factors must be considered and many other similar tests performed to make certainty of such a statement. The fact may be that the person who is naturally unsteady or nervous, may more readily become addicted to smoking. That is, some people may smoke because they are "highly strung" or nervous, and are not so unsteady just because they smoke.

This examination of skill in marksmanship is, of course, preliminary and uncertain. Some of the tests here described could well be omitted for practical purposes, and doubtless all could be improved and new ones should be added. Some may say, in fact, "Why not give a man a gun and let him show his ability by shooting a few times!" Well, there are good reasons. In actual shooting, experience plays too large a rôle. The novice must be shown how to hold the gun, whether to grasp it tightly or laxly, whether his bodily muscles should be held lax or taut, whether he should pull the trigger slowly or with a sudden jerk, how much of the front sight should be visible in the notch of the rear, whether he should aim at the bottom, center or top

of the bullseye, whether he should "hold steady" on the bullseye or move up to it, not to mention the adjustment to and fear of the noise, flash and "kick." The knowledge of these conditions and the adjustment to them depends mostly on experience in shooting, not upon *innate* ability to eventually become a good marksman. The laboratory tests aim to measure this undeveloped ability, although the present series may not do so adequately.

MENTAL TESTS OF UNEMPLOYED MEN

RUDOLF PINTNER and HERBERT A. TOOPS, Ohio State University

PART II.

(Continued from the previous issue.)

Dayton Free Employment Office.

Opportunity was offered to make an investigation at the Dayton Free Employment Office similar to the one already reported. The results of such an investigation would serve as a check upon the work at Columbus. It also serves to show the effect of the environment of the office upon the character of the applicants.

Dayton is a town of 200,000 inhabitants. It is in many respects more of a manufacturing city than Columbus. At the time of the investigation many skilled workers were out of work due to strikes and to munition factories closing down upon the completion of their European war orders. The employment office, in contrast to the one at Columbus, is located on the third floor of a modern business building in one of the principal business streets of the town. The superintendent tries to encourage applications of high grade men and to discourage applications of unemployable and undesirable men.

Forty men were examined during the last ten days of the year 1916. These men represent about 30 per cent of the total

TABLE VIII—DISTRIBUTION OF ALL MENTAL AGES—DAYTON

Mental age	No. of cases	Per cent
7	1	2.5
8	2	5.0
9	3	7.5
10	7	17.5
11	9	22.5
12	4	10.0
13	3	7.5
14	2	5.0
15	..	..
16	3	7.5
16+	6	15.0
Total	40	100.0

new applicants during that period. The tests, questions and methods were exactly the same as in the Columbus investigation. The results, therefore, are directly comparable.

The distribution of mental ages, according to the Point Scale in five cases and according to the other tests in the remainder, is shown in Table VIII. The distribution approaches more nearly to a normal distribution than in the case of Columbus. There is a suggestion here of a division into two classes, one of average ability and one of superior ability. The diagnosis of the 40 cases was: Feebleminded 3; Borderline 10; Backward 13; Normal 8; Bright 6.

Industrial Class.

Table IX shows the relation of mental age to industrial class. The order of these classes both as to numbers and mental index is the same as in the Columbus investigation. No "unemployables" were found in this investigation. The three lowest mental ages of native whites were possessed respectively by an "odd jobs," a questionable "unemployed," and a "casual" worker. All of the colored and foreigners are rated as unemployed, thus indicating a rather high grade of men from an industrial point of view.

TABLE IX—MEDIAN MENTAL AGE OF INDUSTRIAL CLASSES—DAYTON

Indus. Class	No. of Cases	Median M. A.
Unemployed	33	12.0
Casual	2	10.6
Odd Jobs	5	10.2
Unemployable	0	....
Total	40	11.8

Four professional men, prominent in Dayton life, were tested by the same tests. All four had a mental age of 16+. In only a few of the separate tests did any of these four men do poorer than the best of our group of forty.

The relation of mentality to age was found to present similar features to those found in Columbus, namely a tendency for the mental age to decrease as the chronological age increases.

Education.

The median grade at leaving school is 7.4. Compared with Columbus, we find a much smaller proportion of persons leaving in the lower grades, and a much higher proportion reaching the higher grades. We find that 13, or 32.5 per cent of our 40 had at least entered high school. We thus find the

educational attainments in keeping with the higher mentality of the group.

Comparison of the Two Offices.

The composition of the groups at the two offices shows many points of similarity. The Dayton applicants, however, seem to be of a higher quality. This higher quality is in part due to the industrial conditions in Dayton at the time of the investigation and in part to the discouragement of applicants of low quality in that office.

The mental indices of the two groups, 10.5 for Columbus, 11.8 for Dayton, indicate the superior mentality of the Dayton group. The foreign born have the highest mentality in both groups, followed in order by the native whites and colored. There is a significant difference in the mentality of the Columbus whites and colored. The colored applicants are all recent immigrants to Columbus from the South. At Dayton where the colored applicants are mostly Northern born the mentality difference between the two groups is only slightly in favor of the native whites.

By diagnosis it is estimated that the percentage of feeble-minded at Columbus is 28.7, while at Dayton it is only 7.5. There is also a higher percentage of borderline cases at Columbus than at Dayton, 29.8 per cent as contrasted with 25.0. Dayton is credited with a higher percentage than Columbus in each of the remaining mentality groups. This is especially true of the normal and bright groups. The bright group is almost lacking in the Columbus office.

The Dayton office has the largest percentage of desirable men. In the unemployed class there is 82.5 per cent as compared with 64.0 at Columbus. The different industrial classes differ in mentality in each office in the same order: the unemployed have the highest mental index, followed in order by casuals, odd jobs men and unemployables. The last class was unrepresented among the applicants at Dayton. The order of frequency of occurrence of the industrial classes is the same in each office: unemployed, odd jobs, casuals and unemployables.

Comparison with other Investigations.

Johnson[1] in his study of the unemployed of Portland, Oregon, used the Stanford Revision of the Binet Scale. We, therefore, have no assurance that his results are comparable with

[1] Johnson, B. R. Unemployment and Feeble-mindedness, *J. of Delinquency*, Vol. II, 2, 1917. pp. 59-73.

ours. Since his investigation took place during the employment crisis of 1914-1915, while ours took place under more normal conditions, we should not expect the same results even if the tests were comparable. He found about 21 per cent to be feebleminded. We have found 28.8 per cent at the Columbus office. We should expect to find a larger percentage than he did, since under our conditions mentally defective persons would form a larger proportion of the total applicants than at a time of an unemployment crisis, when large numbers of more intelligent applicants are out of employment. The industrial conditions in Dayton may presumably be regarded as much better than those in Portland during the investigation, and accordingly we find at Dayton a smaller proportion of feebleminded, 7.5 per cent as compared with 21 per cent at Portland.

Terman[2] reports the testing by Knollin of 150 hoboes, of which 20 per cent at least were feebleminded and almost as many more borderline cases. Onr findings seem to parallel this report in surprising manner. Indeed many of our men belong undoubtedly to the hobo class.

It is interesting to compare the mental make-up of our group with that of convicted criminals. Pintner and Toops[3] used these same tests in testing the population of a workhouse. The results are directly comparable with the results of the employment office investigations. For purpose of comparison of our men with these workhouse inmates the percentages falling in

TABLE X—PERCENTAGE DISTRIBUTION BY MENTALITY GROUPS IN THE COLUMBUS AND DAYTON EMPLOYMENT OFFICES AND IN A WORKHOUSE

Diagnosis	Dayton Employment Office	Columbus Employment Office	Workhouse
F. M.	7.5	28.7	28.8
Borderline	25.0	29.8	29.6
Backward	32.5	28.7	31.0
Normal	20.0	8.5	10.6
Bright	15.0	4.3	0.0
No. of cases	40	94	132

each mentality group in the three separate investigations are tabulated in Table X. The similarity of the figures for the Columbus Employment Office and the workhouse is startling.

[2] Terman, L. M. *The Measurement of Intelligence*, Houghton Mifflin Company, Boston, 1916. p. 18.

[3] Pintner, R. and Toops, H. A. A Mental Survey of a Workhouse. *J. of Delinquency*. Vol. II. No. 5, Sept.. 1917, pp. 278-287.

All of the investigations we have mentioned show agreement in that a high proportion of mental deficiency is found to be a very decided factor in the production of poor adjustment to the conditions of life now existing. Inasmuch as men are so closely bound up with their industrial life we may expect mental deficiency to show itself by such symptoms as inefficiency, unemployment, vagrancy and crime.

Education of All Applicants.

Since education has such an intimate connection with our problem, being not only in a large measure determinative of the industrial position which an individual is allowed to hold, but also, as shown by the investigation, having an intimate relationship to the mentality of the group, it was decided to determine the educational attainments of all applicants registering at the office for a long period of time. The records of the office allow this to be readily accomplished.

In Columbus a tabulation for four months was made. The median grade at leaving school for the applicants reporting each month was 7.1, 7.2, 6.8 and 7.3 respectively. The median grade for the total 1608 applicants was 7.0. In the report for the four months 19.9 per cent of the total applicants did not report the grade at leaving school. Since the period covered by this tabulation is in the very midst of the period of our investigation, the men selected for examination are largely from this group. Since the men selected had a median grade at leaving school of 6.6, we may regard them as being about equal to the average applicant. They, perhaps, would have been equal had the other 19.9 per cent been reported, many of whom were undoubtedly illiterate and thus not able to report the item on their registration card.

Of the 1608 applicants, 4.3 per cent had never been to school; 9. 5 per cent had not more than a second grade education; 17.6 per cent had at least completed one year of high school, but only 4.6 per cent had completed the high school course; one out of every 58 had entered college, but only one out of 400 had completed a college course.

The median grade at leaving school of 7020 applicants during the entire year at Dayton was 8.3. The forty applicants examined from this office had a median grade at leaving school of 7.4. Evidently the applicants selected for examination were somewhat below the average in educational achievement.

In line with our belief that the grade at which individuals leave school is determined not so much by industrial conditions as by mentality, and in view of our findings, namely that there

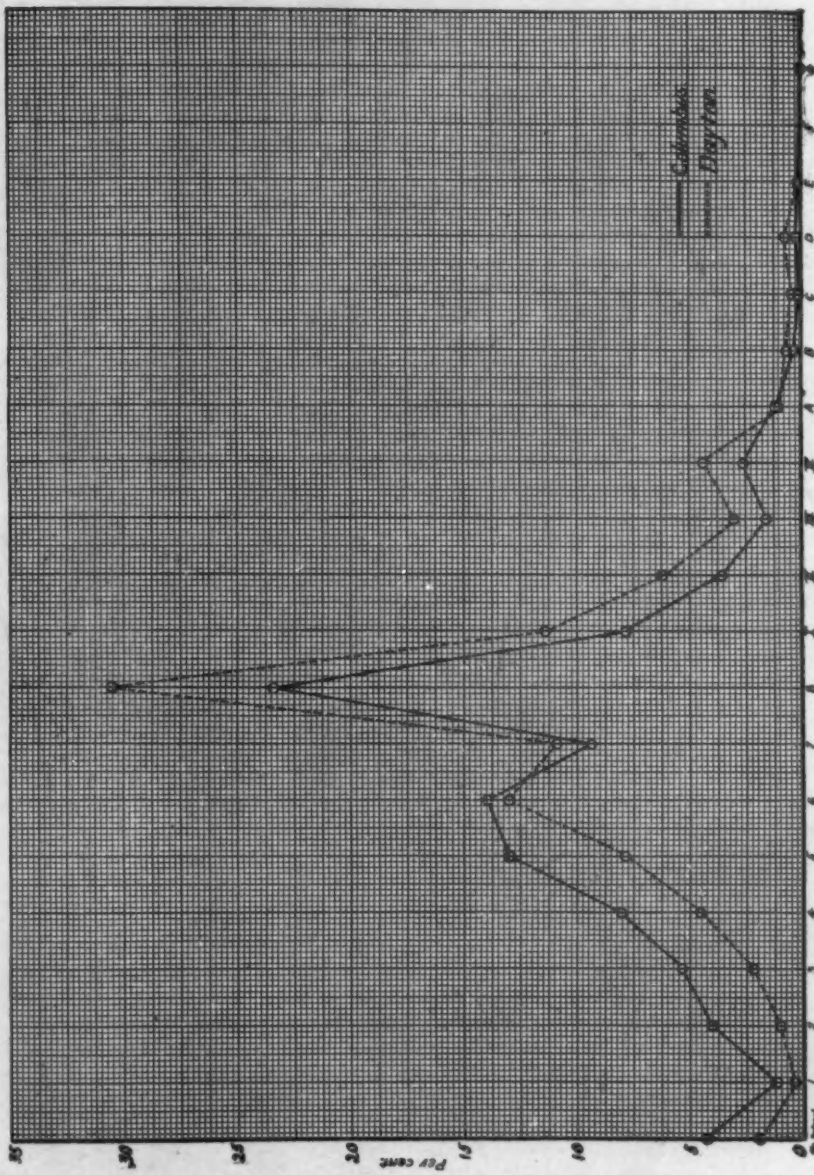
were more applicants of lower intelligence and fewer of higher intelligence at the Columbus office than at the Dayton office, we find that the educational attainments of the two groups corroborate this theory. There is a decidedly larger proportion of applicants leaving school at Columbus before the end of the sixth grade than at Dayton; after the seventh grade, there are decidedly fewer applicants who have secured education of a higher grade. These facts are well illustrated in Graph IV. The effect of the psychology of completion is also well shown in both curves at grades 7 and 8 and at the third and fourth year of high school. We may well believe that the peculiar shape of the curves at these points are due to this factor. Individuals whose limits of ability are about reached at grade 7, and who ordinarily would have dropped out of school at that point, by the prospect of "graduating" by one more year of work, are thereby induced to go to school for one year more. The effect of this upon our curve is to reduce the percentages leaving school at the seventh grade and also at the third year of high school, and to increase the percentages leaving at the eighth grade and the fourth year of high school. The probable effect upon the schools is that the quality of the graduating classes is slightly lowered. This result is, however, not to be regretted, if the additional year of school fits these individuals better for their work after leaving school.

There are probably different amounts of education required as a minimum for success in each particular occupation. What these minimum amounts are, we do not yet know. A further investigation of this would be desirable. If we arbitrarily assume that at least a fourth grade education is required for any of the unskilled occupations, then 10 per cent of the Dayton applicants and 28.8 per cent of the Columbus applicants have not more than this minimum.

Conclusions.

It now remains to be pointed out in what way the results of this investigation may be made of use in a program of industrial and social reform.

We have seen how defective mentality is apt to result in a multitude of social mal-adaptations. The individual so afflicted is unable to compete on equal terms with his fellow men, and consequently soon after beginning his industrial career, starts on the downward path which leads from occasional unemployment to habitual underemployment and may lead to unemployability, through the devitalizing influences due to lack of



Graph II. Percentage of All Applicants Leaving School at Each Specified Grade. Columbus and Dayton.

work and consequent lack of means of support. The last step in the series, as suggested by the comparison of the mentality of the employment office applicants and by the careers of the men themselves, may possibly be actual criminality or, if not that, then entire social dependency.

The social significance of a class of unemployable or habitually underemployed feebleminded men is thus enormous. From a social, industrial and humanitarian viewpoint we should prevent this last step of the series being taken by any individual.

We have also noticed that different degrees of mentality seem quite well correlated with the occupation, wages, permanency of position—in a word, with the industrial success of the individual. A general scheme of social reform would include plans for enabling the individual to develop to the extent of his mental ability and to "find his level" in the industrial world. As Terman says; "The ability to compete with one's fellows in the social and industrial world does not depend upon intelligence alone. Such factors as moral traits, industry, environment to be encountered, personal appearance and influential relatives are also involved." It would thus seem that in many cases of inferior mentality this lack, if not too great, may in large measure be overcome by other factors, chief of which would seem to be proper preparation in school for the later demands to be made upon the individual. The school curriculum of the present does not fit such individuals for life's struggles. Our investigation has shown that such individuals are compelled to leave school after reaching the limit of their ability and before having acquired the training necessary for anything more than sure failure or minimal success in industrial life. A system of vocational education, in which the individual is trained to the extent of his abilities in such ways that the training will be of use in later industrial life, is badly needed. Systematic periodical mental testing of all school children would form one of the important phases of this system.

In regard to the problem of unemployed adults, ideally it would be desirable to eliminate all mental defectives by establishing a state institution where high grade morons could be sent and allowed to work for wages and support themselves to the extent of their ability. This institution would be distinctly different from a "feebleminded institution," in that commitment would be voluntary and that conditions would be such that life in the institution would be more desirable than competition in the struggles of the industrial world. Such a

system could be inaugurated only by a cooperation of state and school and would have to begin with the children.

Since, however, the problems of the employment office are present ones and problems which would cease to exist only after the system just mentioned had been put into successful operation for some length of time, it seems better to recommend a procedure which could be adapted to present conditions.

1. Test the mentality of all applicants by means of group tests.

2. Establish four or five classes, determined primarily by mental age, and ranging from "excellent" downwards, to one of which each applicant may be assigned upon the result of his test. The class of each applicant is to be used in determining to what kind of position the applicant may be referred.

3. Employ a "follow-up" system whereby an applicant's industrial career may be traced. In those cases where perseverance, temperance, industry, etc., would seem to be able, in a measure, to offset the burdens of inferior mentality, the class of an individual may be raised. For opposite reasons the class may also be lowered.

4. Recommend to positions only those persons whose mentality is at least equal to the demands of the position. Refuse to recommend to positions any person belonging to the lowest class.

Let us see what would be the probable outcome of such action. In the first place, we will eliminate a certain element whose employment is of doubtful value, either economically or socially, under any conditions. Society will have to make provision for these dependents and this in turn will hasten the day when provision will be made whereby this entire dependency may be avoided.

Secondly, we may expect a progressive betterment in the kind of applicants who make use of the employment office. This will not only encourage more high grade men to apply at the office when out of work, but also will encourage the use of the office by employers when in need of help, thus materially aiding in securing the results for which the offices were established.

Thirdly, we may expect a decrease in the number of applicants in the beginning, but this may be expected to be temporary only and to be offset by the greater satisfactoriness of the men recommended to positions. One very desirable feature of such a system would be the collection of a vast amount of

industrial information, becoming more and more valuable with the addition of new material, which might be used as a sound basis for a system of vocational guidance of youth. The system might well be expected in time to grow into a bureau in which all men of a community would be registered, and having to do with the granting of standard recommendations, securing promotions, or positions when unemployed, and in the extension of its field of activity to employed as well as to unemployed men, the obtaining of statistics for vocational guidance. In a word such a system stands for industrial evolution while the present system is making no remarkable progress when regarded in the light of industrial and social progress in general.[4]

Summary. 1. A sampling of applicants at two employment offices, as nearly as possible representative of the men in general applying at these two offices, was given a series of mental tests in order to determine approximately the mentality of such applicants in general.

2. The results at the first office show a very high percentage of feebleminded, borderline and backward cases. The percentage of normal or above normal is only 12.8. The percentage of feebleminded and borderline together is 58.5.

3. There seems to be a distinct relationship between the mentality and the industrial class to which a man belongs, the unemployed class ranking highest, followed by the casuals, the odd jobs men, and the unemployables. No men of normal mentality were found in the unemployable group.

4. On the whole the older men among the applicants seem to be more retarded mentally than the younger men.

5. A study of the birthplaces of the applicants seems to show that the class as a group is migratory in character.

6. The best position ever held, as given by the men themselves, shows that few have ever held positions requiring any considerable degree of responsibility.

7. The grade in school achieved by the men, according to their own statement, is higher than their mentality in general

[4]Since writing this article one of the employment offices has become a clearing house for all the large industrial concerns of the city. All the large manufacturers have ceased advertising and rely upon the office for securing their employees. If this principle could be extended so as to include all of the employees in the city, the system would then resemble somewhat the plan outlined above. Have all employees of a community registered in one central office so that recommendations of this office would be worth while, because the records would be complete.

would warrant, although it bears out the poor mental endowment of the class.

8. The median grade at leaving school of the group tested in the one office is 6.6, and in the other 7.4, slightly lower than the median grade for all applicants in either office.

9. The results of the control investigation at the second office bear out in general the results in the first office, with the exception that the general level of the applicants in the second office is above that of those in the first office. The location and method of conducting the office has a distinct influence upon the type of men applying at the office.

10. By means of the mental tests, which we already possess, much could be done to increase the efficiency of our employment bureaus.

CORRELATION BETWEEN DIFFERENT FORMS OF SENSORY DISCRIMINATION

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I. *Introduction*

The study of relationships between mental traits and between mental traits and physical traits has centered mainly about four problems:

1. How are the various mental and physical traits interrelated? Such problems as the correlations between sensory discrimination and memory, between memory and reasoning ability, between motor functions and mental functions, etc., have been studied. The investigations have so far yielded discordant results, and the question of the relative dependence or independence of various traits and functions has given rise to much controversy.

2. How are the various mental and physical traits related to general mental ability or general intelligence? The interest in this problem has been due, no doubt, to the possibility of discovering some one trait or group of traits, the measurements of which might serve as an index of mental makeup. The difficulty of securing an unambiguous measure of general intelligence, as well as a satisfactory measure of special mental traits, has led again to widely varying results.

3. How are the results of mental functions, as shown in school subjects, correlated? The practical bearings of such determinations on the grouping of subjects and their disciplinary value, as well as the light they might throw on the relationship between various mental processes, have led to numerous investigations on correlations between school marks.

4. How are the abilities with varying data in what is in descriptive psychology ordinarily called a single mental func-

tion, correlated? Such problems as the correlation between memory for colors, sounds, numbers, words, etc., between immediate memory and secondary memory, between memories as affected by various modes of presentation, have received some attention.

The accumulating evidence on these four problems has shown a surprising lack of correlation in cases where common observation and opinion would have led one to expect a high correlation (9).[1] The evidence points apparently to a great specialization in mental functions and marked independent variability. So marked is this independence and so contradictory oftentimes to common experience that one is led to suspect that the lack of correlation is due to the presence or absence of factors other than those supposedly measured. Moreover, the more recent investigations have shown that the earlier extreme view of specialization and independence is not tenable. Thus Thorndike (9) is inclined to distinguish at least three levels of mental action—sensitivity, association, and analysis, which would show "closer intro than inter-relations." It is with the correlations within the first of these levels that this investigation is concerned.

The specific problem is the correlation between different forms of sensory discrimination at different stages of practice. The results of the few studies that have been made, have, in general, shown that sensory discrimination is rather highly specialized. That is, high ability in discriminating color or brightness may go with low ability in discriminating tones or pressures or lifted weights or lengths of lines. The evidence has, however, been based either on too small a number of cases to be entirely convincing, or, on a comparison of discriminativeness with varying amounts of practice and interest.

Several questions or problems bearing on the matter have not been satisfactorily worked out:

1. The number of tests necessary to secure an adequate measure of an individual's capacity in discriminations. It is certain that a single test or a few tests will not give a measure of sensory discrimination, whatever else it may give. From a methodological point of view, it is important to discover how great the number of measurements must be in cases where practice is so notoriously effective as in sensory discrimination in order to furnish at least a fairly accurate measure.

2. The correlation between an individual's station in a group

[1] The numbers in parenthesis refer to the title by the same number in the appended bibliography.

in successive stages of practice and with different forms of discrimination. At what point, if ever, in practice does an individual's station become constant, and how does this point vary with different forms of discrimination? This is the problem of the effects of equal practice on individual differences, on which evidence is very meagre.

3. The nature of the change that takes place when discrimination is improved by practice and the factors that account for the improvement.

4. The common factors that may be involved in different forms of discrimination which might bring about an increase in correlation.

The subject of sensory correlation has only in recent years received the attention it merits. Although many psychologists have recognized the importance of the problem and have made it the object of experimental inquiry, very few have been at all satisfied with their results. In fact, there has scarcely been a statement made concerning sensory correlation that has not been seriously questioned by other investigators in the field. The extremists, on the one side, maintain that the correlation between different sensory abilities is high and that the correlation between sensory discrimination and general intelligence is very high, or, perfect; while others maintain that there is little or no correlation. Between these two extremes we find all degrees of variation.

II. *Description of Experimental Work*

A. Tests—General Description. The experimental work of this investigation is concerned with four forms of sensory discrimination,—the Discrimination of Pressure, of Length of Lines, Auditory Discrimination, and Brightness Discrimination. Each test was carried on for ten consecutive days and as nearly as possible at the same period of the day. There were fifty judgments to be given in each day's test, or five hundred judgments for each type of discrimination, so that in the four tests two thousand judgments were given by each subject. The eight subjects made, in all, sixteen thousand judgments. The method of right and wrong cases was used throughout and the order of stimulation in each test was determined by chance. These four tests were used partly because of the fact that previously published results have dealt with these forms of discrimination and partly because of the readiness with which they lend themselves to the measurement by the method of right and wrong cases.

B. Order of Tests. The four tests were given in the following order to all subjects:

1. Discrimination of Pressure.
2. Discrimination of Length of Lines.
3. Auditory Discrimination.
4. Brightness Discrimination.

This order was adhered to strictly for the reason that the various tests given to the different subjects would be made under the same conditions as far as the effects of practice were concerned. It was not in the province of this study to deal with the transfer of practice.

C. Subjects of the Experiment. Eight individuals were chosen, varying in age from seventeen to forty years of age, with different degrees of training, experience and interests. All subjects, however, had as a minimum the high school grade work. Two subjects were in the graduate department of Educational Psychology; one an instructor in Psychology; one a senior in the Literature and Science Course; one Junior; two Sophomores; and one Freshman in the College of Agriculture. One of the Sophomores and the one Freshman were mature men, the Sophomore being a man of twenty-nine years of age, a graduate of a Normal School and having been a superintendent of schools for four years. The Freshman was a man of twenty-four years of age and had taught in a city school system for three years. The Junior and the other Sophomore were average University students in the College of Agriculture.

The first four subjects named were men of wide experience both in teaching or educational training and in the laboratory work of Educational Psychology.

The interest of all the subjects was exceedingly good, and every effort was made to make the tests accurate. There was a decided effort, at all times, to make as high a record as possible. The writer, in most instances, gave a brief description of the purpose of the experiments in order that there would be an interest aroused by the subjects in their results. This type of motivation functioned exceedingly well and helped to stimulate each subject to his maximum effort in each test.

D. Description of the Apparatus and Methods Used. A brief description of each test will be outlined below:

a. Discrimination of Pressure

In this test Whipple's Pressure-Pain Balance was used with a weight of 200 grams at the outer end of the lever and an

increment weight of 20 grams. Each subject took a comfortable position—the instrument being so placed that the subject's wrist came just over the edge of the table. The hand could then lie upon the hand rest, with the end of the forefinger projecting straight forward between the two tips of the balance. The upper tip was so arranged as to come in permanent contact with the center of the finger nail. The subject closed his eyes; at the word "Now," the first stimulus was given and two seconds later the second one was given. The subject was required to state, in terms of the latter, whether it was heavier or lighter. Every effort was exerted by the experimenter to make the two stimulations of the same duration and the same degree of application. Occasionally the writer would stop and allow the subject to remove his finger for a short period, perhaps fifteen or twenty seconds, as many subjects felt a sort of numbness after a number of stimulations had been given.

b. Discrimination of the Length of Lines

For the discrimination of length of lines eight cards, on which were engraved lines 20 and 20.3 mm., were exposed, by means of the Jastrow memory apparatus. The cards were so arranged in series that the chance order of presentation was maintained.

The subject was seated before the apparatus in such a manner that his eyes were on a level with the lines. Then a pair of lines were exposed for two seconds, the record of the time being kept with a metronome, beating seconds. The subject was required to judge whether the right line was longer than the left throughout one whole test. Then, in the following day's test, the subject was required to judge the left in terms of the right, and so alternating throughout the ten tests.

c. Auditory Discrimination.

Seashore's audiometer was used for the tests in Auditory Discrimination (11). A room was chosen which would be as free from noise as possible. The subjects were instructed to make use of their keener ear. All of the subjects, however, were normal in the point of hearing. One stimulus was placed at 28 and the other at 29 on the scale of the audiometer. The stimuli were given in chance order, care being taken to make the tests of the same duration. The subject assumed a comfortable position, closed his eyes and kept them closed through-

out the experiment. The judgments were given first in terms of the first stimulus, then, in terms of the second.

d. Brightness Discrimination.

Whipple's apparatus for brightness discrimination was used for the tests in brightness discrimination (11). The apparatus is a box fitted with a high-power frosted Tungsten lamp, the light of which is reflected from two independently adjustable white screens upon two oblong translucent windows, so placed in the face of the box as to give out as nearly as possible the same amount of light when the levers are set even on the scale.

The apparatus was set up in a dark room and in such a position that the subjects' eyes came even with the apertures. The levers regulating the reflectors were placed even at first in order to regulate the position of the apparatus so that the lights of the two would appear equal in intensity to the subjects. One lever was then set at 120° and the other at 115°. The order of brightness in the two windows was one of chance. The subject was required to judge whether the right was darker or lighter than the left in one test, and the left in terms of the right in the next, and so on, alternating each test. Between tests the subject closed his eyes and kept them closed until the writer gave the signal, "ready."

III. *Results and Discussion of the Experiments with the Several Groups of Tests*

The gross results of the various tests are indicated in Table I. This gives the per cent of right cases in the four tests for the eight subjects, together with the averages and mean variations.

TABLE I

Subjects	Daily Tests	Pressure	Lines	Sound	Brightness
1	1	70	72	74	74
	2	72	74	76	78
	3	78	76	82	80
	4	76	78	84	84
	5	84	84	88	88
	6	88	82	90	92
	7	90	82	90	92
	8	94	84	92	92
	9	94	88	88	88
	10	98	88	94	94
	Av.	84.4±8.3	80.8±4.6	85.8±5.4	86.2±5.6

TABLE I—*Continued*

Subjects	Daily Tests	Pressure	Lines	Sound	Brightness
	1	64	66	76	72
	2	68	74	80	80
	3	78	80	82	84
	4	66	76	82	86
2	5	84	78	80	82
	6	82	80	88	86
	7	82	82	86	88
	8	84	80	88	90
	9	86	80	88	90
	10	80	86	86	88
	Av.	77.4±6.8	78.2±3.7	83.6±3.6	84.6±4.0
	1	56	68	88	88
	2	64	72	86	90
	3	64	82	86	92
	4	78	86	82	92
3	5	80	90	84	94
	6	84	84	88	94
	7	86	86	90	94
	8	82	90	88	90
	9	86	92	86	90
	10	84	84	92	94
	Av.	76.4±9.0	83.4±5.6	87.0±2.2	91.8±1.8
	1	74	68	74	68
	2	76	70	76	70
	3	78	74	82	74
	4	84	70	78	72
	5	78	70	80	84
4	6	80	76	84	80
	7	84	82	86	86
	8	82	80	88	88
	9	92	84	88	92
	10	90	88	84	90
	Av.	81.8±4.5	76.2±5.8	82.0±4.0	80.4±7.6
	1	70	68	70	72
	2	62	66	68	78
	3	72	74	74	74
	4	84	82	80	84
5	5	82	84	86	86
	6	86	88	84	84
	7	82	80	88	90
	8	88	86	94	96
	9	90	86	90	94
	10	96	90	96	96
	Av.	81.2±7.9	80.4±6.7	83.0±8.0	85.4±7.0

TABLE I—*Continued*

Subjects	Daily Tests	Pressure	Lines	Sound	Brightness
	1	70	70	76	82
	2	72	76	82	88
	3	76	74	86	90
	4	80	84	82	92
	5	90	80	84	88
6	6	90	86	88	92
	7	84	80	84	92
	8	88	82	88	94
	9	86	92	88	90
	10	88	94	92	94
	Av.	82.4±6.3	81.8±5.8	85.0±3.4	90.2±2.5
	1	76	74	76	76
	2	80	72	82	88
	3	82	78	74	86
	4	78	76	74	90
	5	84	80	88	88
7	6	90	80	90	92
	7	90	80	92	94
	8	90	82	90	90
	9	92	86	88	92
	10	92	88	92	92
	Av.	85.4±5.4	79.6±3.6	84.6±6.4	88.8±3.4
	1	68	70	78	84
	2	76	80	80	90
	3	88	82	82	94
	4	86	90	84	96
	5	84	86	88	96
8	6	86	92	90	94
	7	86	92	88	96
	8	92	84	94	98
	9	92	90	92	96
	10	98	98	96	98
	Av.	85.6±5.7	86.4±6.0	87.2±4.9	94.2±2.9

The following coefficients of correlation are calculated by the rank method developed by Spearman and also by the product-moment method of the Pearson-Bravais Formula.

TABLE II

Coefficients of Correlation of the Different Sensory Tests

	Spearman	Pearson
Lines and Sound Discrimination	+.90	.92
Brightness and Sound	+.90	.96
Pressure and Lines	+.39	.20
Pressure and Sound	+.36	.13
Lines and Brightness	+.92	.92
Pressure and Brightness	+.41	.20

The most striking result revealed by the experiments consists in the very high correlations shown between the ranks based on the averages in all of the tests and particularly between sound, brightness and line discrimination. The correlations are very much higher than those reported by previous authors. A comparison with Burt's results shows this very clearly. He found correlations for discrimination as follows:

	Average
Touch and Weight	+.49
Touch and Pitch	+.12
Touch and Length	+.23
Weight and Pitch	+.29
Weight and Length	+.00
Pitch and Length	+.09

Thorndike similarly finds a loose correlation between different forms of discrimination. Moreover, not only are the correlations for different sensitivities low or absent entirely, but even the correlation between drawing a line to equal a 100 mm. line and one equal to a 50 mm. line is only +.77. The results in other words point not only to a high degree of independence of different forms of discrimination but also of any single form with varying data or content. My own results, however, show very close interrelations between the different sensory abilities when a sufficiently large number of experiments is made to furnish an adequate measure of an individual's capacity. Most of the investigations previously made, from which the conclusion has been drawn that the "sensitivities interrelate very loosely," have been based on one or a few experiments with large groups. The reliability of the coefficients is, therefore, low. Certainly when the ranks in any tests are based on ten series of experiments, each involving fifty judgments, there is no question that the coefficients are very high and the reliability great. The only departure is in the correlations with pressure discrimination. The experiments on pressure, however, are the least reliable because of certain sources of inaccuracy in the administration of the tests by the experimenter. With the particular type of instrument employed it is difficult to maintain constancy in the duration of the stimulus and to maintain a uniform rate of application of the stimulus, and, consequently, to avoid variations in amount of pressure. Moreover, the constant error arising when the lighter stimulus comes after the heavier affected the results with some subjects, notably subject 4 who gave but 2 erroneous judgments out of 250,

when the heavier stimulus followed the lighter. A further factor in reducing the coefficients is the fact that one subject ranked 8 in pressure discrimination and 2 in all the other tests. With the rank method of correlation the differences of rank, 6 in each pair of correlations, reduced each of the coefficients .42. With a larger number of cases this factor in reduction would be less effective. The correlations with the 7 subjects for pressure with length of lines is .61, with sound .75, with brightness .74.

The coefficients by the Pearson method were calculated for purposes of comparison with those of the rank method. The differences resulting are, in some cases, very marked. An inspection of the actual results in the tests suggests that neither method gives an adequate expression of the amount of correlation. The Pearson method tends to give undue weight to the extreme deviations from the average, while, on the other hand, the rank method gives undue weight to small differences.

The highest correlation is between discriminations of length and of brightness. This might, perhaps, be attributable to the fact that the same sense organ is involved. The correlations indicate that the subjects who had difficulty in discriminating brightness also had difficulty in discriminating length. Moreover, the correlations between brightness and length discriminations with the other forms are very similar.

Length with Sound Discrimination	+.90
Brightness with Sound Discrimination	+.90
Length with Pressure Discrimination	+.39
Brightness with Pressure Discrimination	+.41

However, the correlations between sound discrimination and discrimination of length or brightness are almost as close as the correlation between brightness and length. Some other underlying factor must have been involved. The explanation of the high correlations obtained between the different forms of sensory discrimination studied seems to demand a modification of the extreme view of specialization and independent variability of mental functions of which Thorndike has been the chief defender. Some intermediate position between that taken by Thorndike and the one maintained by Spearman is suggested. In the face of these results, one could scarcely hold that the different forms of discrimination interrelate loosely. Interrelation is close but by no means perfect. Moreover, two of the factors which might cause high correlations have been eliminated as far as possible; namely, variation in the conscientiousness and good will of

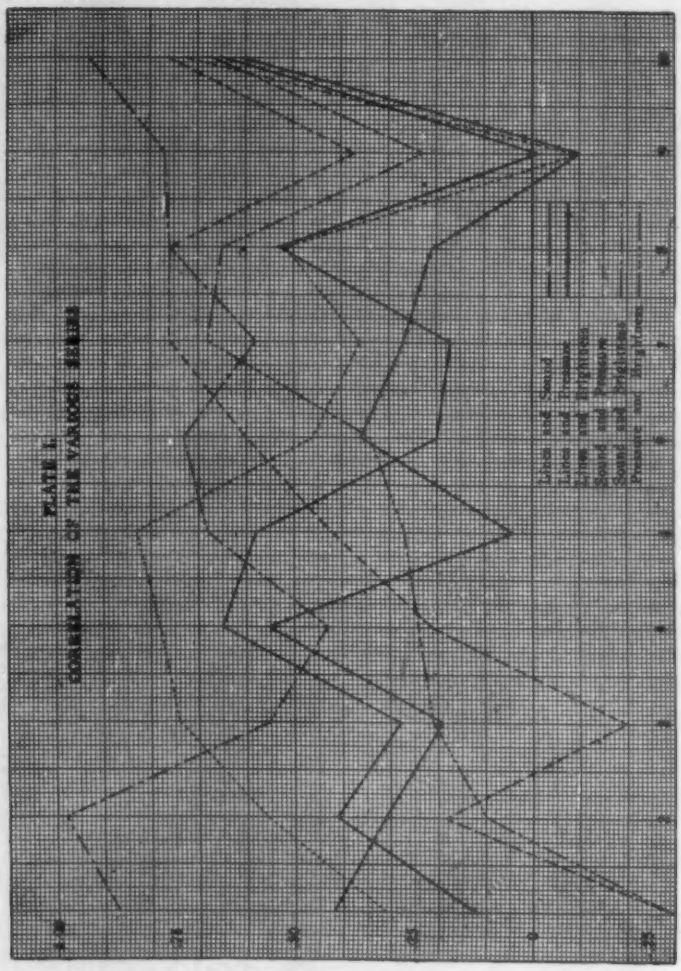
the subject, and variation in the amounts of practice. If, in a group of subjects, some were conscientious observers and others not, the ranks might give an appearance of correlation, but this correlation is in conscientiousness and not in discrimination. Again, if in a group the subjects tested started at different stages of practice and training, the result might, on a basis of ranks, either give a high correlation or a low correlation, but the coefficient would not then measure sensory discrimination, but something else. With these factors eliminated, we are reduced to some other common factor or factors which might be operative. Spearman's hypothetical "Central Factor" is suggested, but it is obscure and mysterious. To appeal to it is but to cloak our ignorance. An extension of this investigation with a further analysis of the factors involved is contemplated. Until such results are at hand, a definite attempt at explanation will not be ventured by the writer.

One of the purposes of this investigation was to study the correlations shown at different stages of practice. From the point of view of method in mental tests it is important to determine the number of tests necessary to give a reasonably accurate coefficient of correlation. Moreover, such a study would throw light on the course of practice itself. Theoretically, one might expect, since the real effect of practice is to reduce variability, that the coefficient of correlation in successive stages of practice would become high. This would be true however only on the supposition that practice took much the same course in different individuals, and that the effects of practice on different individuals, and with different forms of discrimination were equal. The results of correlation based on the averages of the first two, the fifth and sixth, and the last two tests, appear in Table III. The results of Table III are graphically represented in Plate I.

TABLE III

Correlation Based on First Two, Fifth and Sixth, Eighth and Tenth, and Last Two Tests

Series	1 and 2	5 and 6	9 and 10	8 and 10
Lines and Sound	.56	.55	.77	.96
Lines and Pressure	.11	.16	.48	.58
Lines and Brightness	.64	.84	.78	.93
Sound and Pressure	.00	.70	.77	.82
Sound and Brightness	.93	.83	.77	.90
Brightness and Pressure	—.18	.41	.44	.68
Average	.40	.58	.67	.81



There is a general increase in the coefficients but the increase is not very marked, partly due to an unaccountable fluctuation in the ninth step of experiments. The correlations with each of the ten series of tests appear in Table IV.

The effects of practice in the different tests are indicated in the plates. In every case, there is a marked improvement. The course of practice is similar with the different individuals and with the different forms of discrimination. Practice

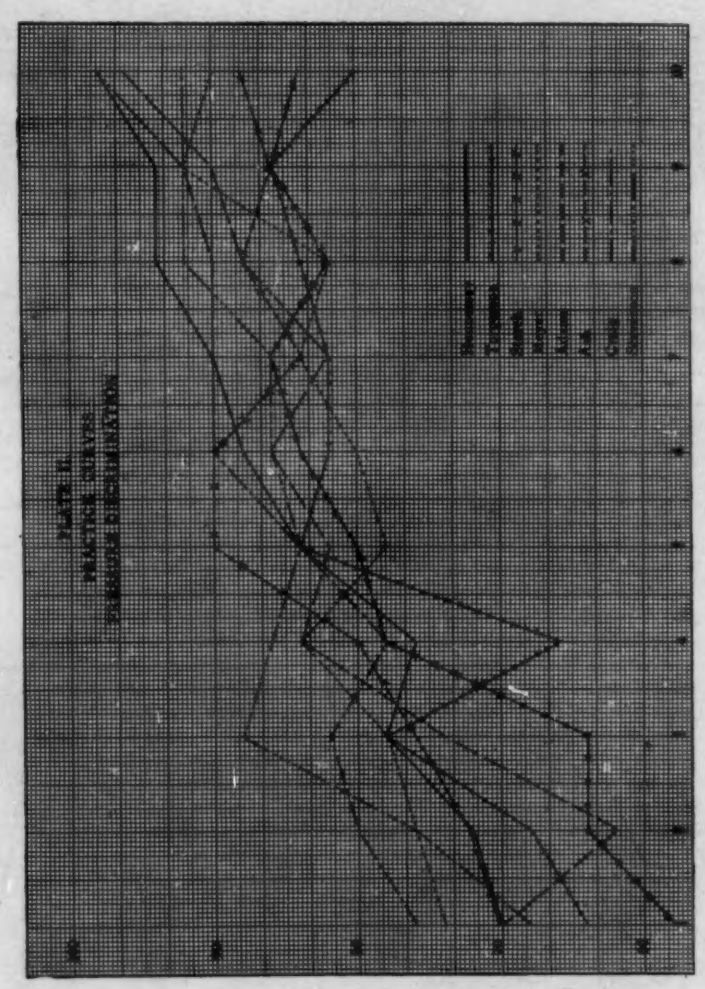


TABLE IV

Table of the Coefficients of Correlation of the Ten Series of Sensory Tests

Series	1	2	3	4	5	6	7	8	9	10	Av.
Lines and Sound.....	.12	.41	.28	.65	.58	.20	.17	.53	.01	.65	.37
Lines and Pressure.....	.42	.31	.19	.55	.04	.36	.27—	.21	.10	.61	.31
Lines and Brightness...	.31	.56	.74	.78	.83	.46	.36	.52	.10	.72	.54
Sound and Pressure....	.30	.18	.20	.21	.42	.60	.76	.76	.37	.76	.46
Sound and Brightness..	.87	.98	.55	.43	.68	.73	.58	.76	.77	.93	.73
Brightness and Pressure	.30	.10	.21	.24	.27	.34	.68	.65	.23	.67	.37
	.39	.42	.35	.48	.47	.45	.47	.57	.26	.72	

effect is most marked in the discrimination of pressure, and the increase is gradual.

IV. *Conclusions*

The results of this investigation seem to justify the following conclusions:

1. The correlations between different forms of sensory discrimination are, in every case, positive and usually very high. The range is from .39 to .93. When correction is made for accidental variations, the range is from .71 to .93. These coefficients justify a modification of present-day opinion with regard to the independence of different sensory abilities.

2. The effect of practice is to increase the coefficients. This was shown by calculating the coefficients from the first two, fifth and sixth, and last two tests, and by calculating the coefficients for each of the ten series of experiments.

The coefficients fluctuate considerably, and there appears to be no point in the course of practice where an individual's station in the group becomes relatively constant.

3. The correlations are highest between brightness and length discrimination, but they are practically as high between sound discrimination and brightness or length.

4. Pressure discrimination correlates least with the other tests. Certain unavoidable sources of inaccuracy in making experiments account in considerable part for this fact.

5. The effect of practice is similar in the different tests and with different individuals.

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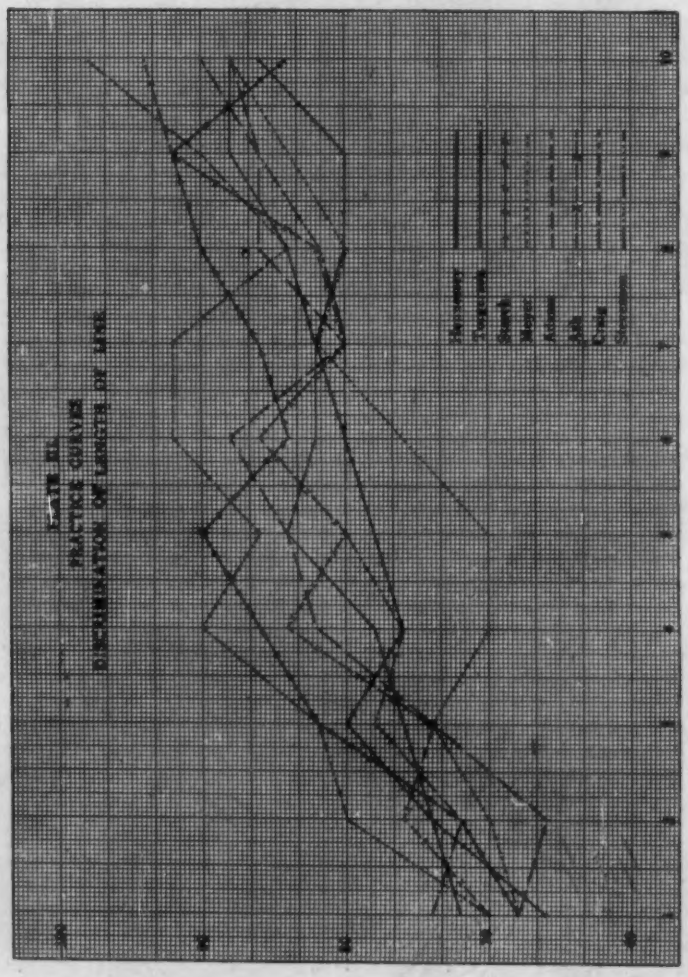

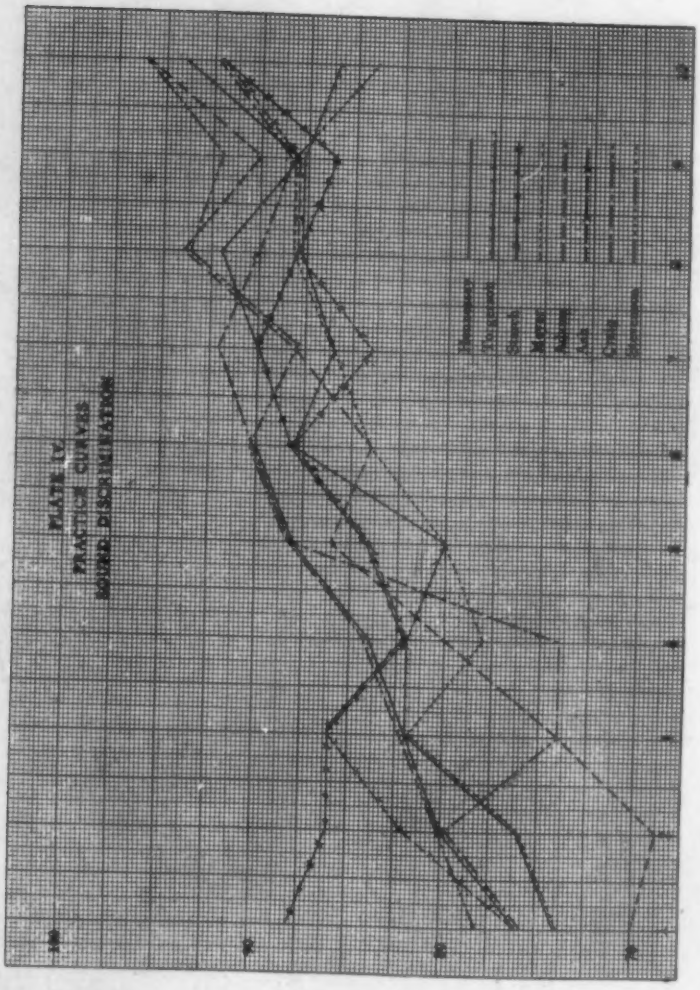
PLATE IV
BOARD DISCRIMINATIONS
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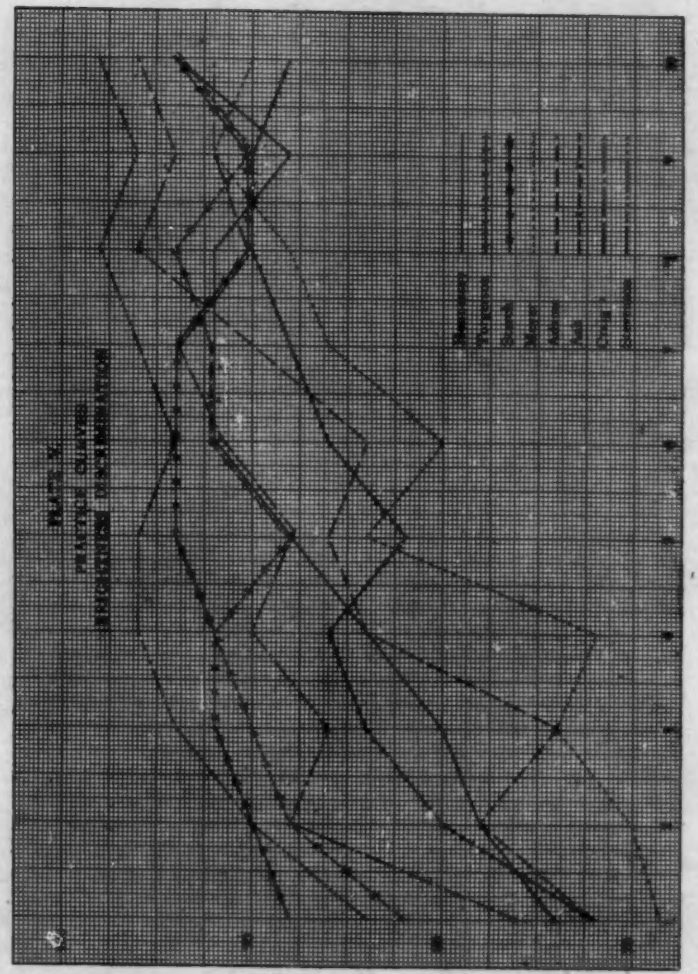
PAPER CUP



A SCALE OF INTELLIGENCE OF COLLEGE STUDENTS FOR THE USE OF COLLEGE APPOINTMENT COMMITTEES[1]

By R. P. JARRETT

Applied psychology has a great influence in various lines of endeavor today. The aid of the psychologist is secured by large corporations in order to reduce expenses in employing new salesmen. The government of the United States seeks his help in testing the general mental ability of the foreigner when he comes to this country. The psychologists of this country are doing their bit in the present crisis by attempting to classify the soldiers so that promotion can be made on a proper basis. It seems reasonable, therefore, to suppose that students of colleges and universities could be classified on the basis of their probable success in life in such a way that the appointment committee would be more able to do effective work.

With this idea in mind, the writer, under the direction of Professor Edward K. Strong, Jr., made a study during the spring and summer of 1917 of the subject; "How to secure the most reliable rating of students by members of the faculty for purposes of the appointment committee." This study[2] was divided into three sections: (1) methods used by the appointment committees of colleges, universities, and normal schools for the purpose under consideration; (2) the relation of mental tests to college grades, faculty rating, and value of position held by the students after leaving college; and (3) the development of a scale of intelligence by Peabody students. This paper refers to the last section of the general study.

In the first section of the study it was found that a few institutions of higher learning in the United States have the members of the faculty rank the students who are in their classes. None of the schools replying to our questionnaire have a comparative ranking of those seeking the services of the appointment committee by which all are compared together on the same basis. The rankings, moreover, in the various classes do not seem to be scientifically based upon the various elements that have to do with success in life. In fact, the members of the faculty do not seem to have any concrete

[1]From the Psychological Laboratory of George Peabody College for Teachers.

[2]An unpublished thesis by this title in the college library.

basis upon which to make their judgments. In no case do we find any sort of scale for the use of the members of the faculty in making their judgments.

In order to get a comparative ranking that is of greatest value, it should be based upon several important principles. (1) The judgments should be made upon the various elements that make for success in life. (2) The judgments should be made with a well-developed scale as a basis. (3) The combined judgments of several competent persons should be secured, the greater the number the better. (4) Provision should be made for omitting the extreme judgments, for in all probability they are the results of undue influences.

During the school year 1915-1916, Dr. Strong had one-hundred students of George Peabody College for Teachers ranked from one to one-hundred. With this as a basis, he devised a scale of ten equal steps. The distribution was made on the basis of the standard deviation. The names of several students were then placed in each of these steps, the ranking enabling him to select the proper names for each step. The name of each student registered in Peabody College was placed on separate slips of paper. Fourteen members of the faculty of Peabody College then placed the name of each student registered in the institution in the step of the scale in which he thought it belonged. This gave a comparative ranking of all the students based upon the preliminary scale.

Under Dr. Strong's direction, several names were then taken from each step in the general distribution of Peabody students who were ranked by the fourteen members of the faculty. This gave a scale of nine steps on basis of P. E., ranging from — 4.00 P. E. to + 3.50 P. E., the steps representing 1 P. E., with the exception of the step between group 1 (+ 3.50 P. E.) and group 2 (+ 3.00 P. E.) which was equal to only 0.50 P. E. The general distribution and formation of the scale is shown by the following table or diagram:

SCALE OF GENERAL INTELLIGENCE OF PEABODY STUDENTS

(Group 1: most intelligent. Group 9: least intelligent. Group 5: average.)

					m w		w		
					m w		w		
	*w			w	m w		w		
	w		m w	m w	m w	w	m w		
	w	†m w	m w	m w	m w	w	m w	w	
	w	m w	m w	m w	m w	m w	m w	m w	m
	w	m w	m w	m w	m w	m w	m w	m w	m
	5	6	8	9	14	6	11	5	2
Group.....	IX	VIII	VII	VI	V	IV	III	II	I
P.E.....	—4.0	—3.0	—2.0	—1.0	—0.0	+1.0	+2.0	+3.0	+3.5

* Women. † Men.

Through the aid of the chairman of the appointment committee of the College each member of the faculty was sent a letter, a copy of the new scale, and a list of the students registered in George Peabody College for Teachers during the school year 1916-1917. The letter explained the formation of the scale and asked that a rating be made of the students whom the instructor knew (through class work or in a personal way). Ratings were to be in terms of *General Intelligence*, and all characteristics of the individual making toward success in life were to be considered.

The scale was sent to the faculty in the following form. For obvious reasons, the names of the students cannot be placed here.

SCALE OF GENERAL INTELLIGENCE OF PEABODY STUDENTS

(Group 1: most intelligent. Group 9: least intelligent. Group 5: average.)

Group 1		Group 4		Group 7	
			w 14	m 22	w 30
			w 15	m 23	w 31
m 1	w 1	m 9	w 16	m 24	w 32
m 2	w 2	m 10	w 17	m 25	w 33
Group 2		**Group 5**		**Group 8**	
		m 11	w 18		
		m 12	w 19		
		m 13	w 20		
	w 3	m 14	w 21		
	w 4	m 15	w 22	m 26	w 34
m 3	w 5	m 16	w 23	m 27	w 35
m 4	w 6	m 17	w 24	m 28	w 36
Group 3		**Group 6**		**Group 9**	
	w 7				
	w 8				
	w 9		w 25		w 37
m 5	w 10	m 18	w 26		w 38
m 6	w 11	m 19	w 27		w 39
m 7	w 12	m 20	w 28		w 40
m 8	w 13	m 21	w 29		w 41

Sixteen members of the faculty made the rating called for. One new addition to the faculty was unable to make a report on account of the fact that he did not know most of the people placed in the scale. As a rule, those students who were here only a short time during the fall quarter were not rated by many members of the faculty. The following table indicates the general distribution of the number of ratings received by the different students.

NUMBER OF STUDENTS; AND NUMBER OF RATINGS GIVEN

Entire number of students	493
Number rated thirteen times	1
Number rated twelve times	2
Number rated eleven times	11
Number rated ten times	13
Number rated nine times	18
Number rated eight times	19
Number rated seven times	24
Number rated six times	44
Number rated five times	55
Number rated four times	45
Number rated three times	58
Number rated two times	62
Number rated one time	75
Number not rated	68

It is believed that a rating based upon the combined judgments of a great many competent judges is better than a rating based upon the judgments of a few competent judges. But on account of the fact that many of the students in George Peabody College for Teachers come in contact with no more than four teachers, it has been necessary to consider four ratings as sufficient in getting the general distribution of intelligence of Peabody students.

In order to guard against prejudice, the highest and the lowest ratings are discarded. The average of the remaining ratings is taken as the rating of the individual.

The general distribution of intelligence of Peabody students is indicated in the following table.

DISTRIBUTION OF INTELLIGENCE OF PEABODY STUDENTS

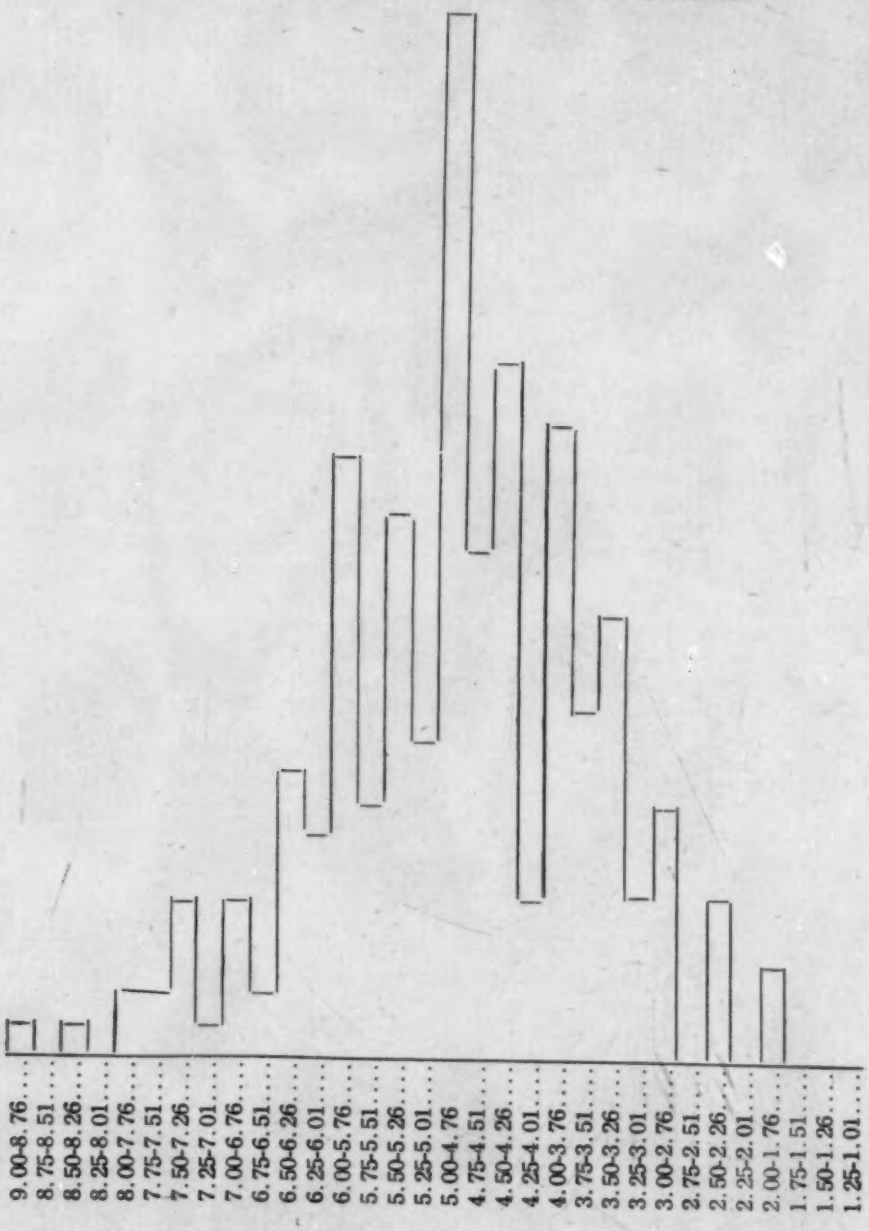
P.E.	Rating	Number receiving rating
+4.00	.....	0
	1.00–1.25	0
	1.26–1.50	0
	1.51–1.75	0
+3.00	1.76–2.00	3
	2.01–2.25	0
	2.26–2.50	5
	2.51–2.75	0
+2.00	2.76–3.00	8
	3.01–3.25	5
	3.26–3.50	14
	3.51–3.75	11
+1.00	3.76–4.00	20
	4.01–4.25	5
	4.26–4.50	22
	4.51–4.75	16

DISTRIBUTION OF INTELLIGENCE OF PEABODY STUDENTS—*Continued*

P. E.	Rating	Number receiving rating
0.00	4.76–5.00	32
	5.01–5.25	10
	5.26–5.50	17
	5.51–5.75	8
—1.00	5.76–6.00	19
	6.01–6.25	7
	6.26–6.50	9
	6.51–6.75	2
—2.00	6.76–7.00	5
	7.01–7.25	1
	7.26–7.50	5
	7.51–7.75	2
—3.00	7.76–8.00	2
	8.01–8.25	0
	8.26–8.50	1
	8.51–8.75	0
—4.00	8.76–9.00	1

The general relation of the various elements of this distribution will be more apparent by plotting a curve of the distribution. This is shown by the following plate.

DISTRIBUTION OF INTELLIGENCE OF PEABODY STUDENTS



The distribution is very near a normal curve. No student is rated higher than step 2 of the scale, while only two students are placed lower than step 8 of the scale, one of those being placed as low as step 9. This general condition is to be expected, for if one teacher, not including the two ratings excluded to guard against prejudice, should give an individual a rating lower than one, his final rating could not be that high. This is correspondingly so, of course, for group 9. There are many fluctuations in the several groups of the distribution, but this is to be expected on account of the small number of individuals considered. Also, dividing the steps into four divisions tends to make the distribution irregular.

As has been said, the general character of the distribution is as near a normal curve as could be expected. The mode is the 4.76-5.00 group, and the median of the distribution falls within this group. One hundred and nine ratings fall above the mode, and eighty-nine fall below it. Only two persons have a rating approximating the ninth step of the scale, and but three persons have a rating within ½ P. E. of the highest step of the scale.

The ratings given in this study should be more reliable than those given by individual members of the faculty, for the combined judgments of several people should be of greater value than that given by one person. Also, the fact that the extreme rankings were thrown out should tend to make the final results more reliable, for the extremes are likely to be influenced, for or against, by factors that do not indicate the real strength of the individual. The fact that those making the ratings had a scale before them should tend to result in more accurate ratings, because the traits of one person could be judged better by having a measure or scale than they could be without any concrete basis upon which to make the ratings. The fact that the scale was made to conform to the judgments of several persons, and that representative persons in each group were taken for each division or step of the final scale, should tend to aid those making the rating.

The development of a scale of this character, and the ratings by several persons, each having in mind the various elements that make for success in life, make it possible to get ratings that do not have the faults found in an individual rating. Under present conditions, the influence of scholarship is stressed too much, the reports are often too lax, etc. The use of the scale prevents to a large degree the effect of such elements as these.

The first section of the general study i.e., concerning meth-

ods now in use by appointment committees revealed the fact that only small groups, members of classes, were rated, and as a result the appointment committee might be called upon to choose between two individuals who were not considered in the same rating. Under this condition there would be no way to compare accurately the two individuals. The plan given here places in the hands of the appointment committee the comparative ratings of all students registered with the committee.

The plan should be of greater value than the methods now in use, because the individual is rated in terms of his total efficiency rather than upon certain particular characteristics. As we do not know the value of specific characteristics nor how to combine them into a sum total, a grading upon general intelligence is certainly safer today.

The next question that arises is, Can the scale be used successfully from year to year? The following facts indicate that the scale can be revised easily and that it should become more accurate with each revision. (1) The names placed on the scale are well known by the members of the faculty, and for this reason they can be used successfully for two or three years. (2) New names can be placed in the scale from year to year, because each year all of the students will be rated on the basis of the scale and representative students from each group can be placed in the scale and the names of those who have been away from the college more than one or two years can be taken out of the scale. Suppose the first man used in step 3 of the scale has been away two years in 1919, and for this reason the members of the faculty do not remember his characteristics so well as they do those who were in school the previous year. Step 3 in the general distribution for the previous year would have the names of several men. These could be placed in the scale and the names of those who have been away from the college for two or three years could be dropped.

The following conclusions seem to be justified:

1. The scale should become more accurate, for the reason that the record of those who secure positions can be obtained and this can be studied in connection with their ratings.

2. The use of the scale should meet the approval of the members of the faculty, because it will not require more than thirty minutes for each teacher to make the ratings of all the students he knows in the institution.

3. It is true that some of the names in the scale will not be placed in the proper position so far as the individual opinion

of the instructor is concerned, but he should recognize the fact that the combined judgments of several persons should be more reliable than his judgment. The fact that he rates the student in terms of the scale makes it possible for him to prevent the undue influence of any prejudice that he may have in regard to the individual.

4. The use of the scale will enable the appointment committee, in later years, to find the correlations between what the person does in the field, his rating on the basis of the scale, and the record he makes in mental tests.

5. Finally, the rating of the individual should not be considered the total basis for appointment. It should be supplementary to the information that the committee receives on the blanks now in use and from the record the person makes in the mental tests. In other words, the report of the instructor gives his individual opinion, the tests show the general mental ability of the student, and the rating gives the combined judgments of several competent persons and is based upon a scale that has been carefully developed with due consideration to all of the elements that make for success in life.

A CONTRIBUTION TO THE STUDY OF INSTRUMENTAL MUSIC

By SAMUEL E. POND, A.M., Clark University

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I. *Introduction*

This investigation aims to make a contribution which may be of service in mastering the technique of musical instruments, and especially of the French horn. The study was undertaken with a view to discovering the causes of difficulty in executing certain passages; but as the work progressed it became evident that the means which we employed for isolating the troublesome factors might be of service in improving the player's technique. The investigation in its final form aimed to throw light upon the following questions: What are the essential characteristics of the behavior involved in the mastering of a musical instrument? What mental processes play a part in directing the player's activity? In what order do these mental processes make their appearance? Does the turning of one's attention to these mental processes furnish a means for improving the player's technique? Numerous other problems have been raised during the course of the investigation, but we are concerned here only with those which are fundamental to the overcoming of the chief difficulties which are discussed in this paper.[1]

[1] This investigation has been carried on simultaneously with the laboratory course in experimental psychology at Clark University during the years 1915-17; earlier observations were made (1914) which suggested the need for intensive study. The author is indebted to the members of the department for criticism and suggestions; he

The French horn belongs to the brass-wind group, and it is utilized by the larger orchestras. The instrument consists essentially of a tapering tube, about eight feet long and coiled three and a half times; it has a flaring bell at one end of this tube, and a small conical mouthpiece at the other end.[2]

The pitch of the tone emitted by this instrument is varied and controlled by three devices: (1) The instrument is provided with three valves, the opening of which has the effect of increasing the length of the tube. That is, they lower the pitch of the tone; and the amount of lowering by means of this device may reach a maximum of six semi-tones. (2) By partially closing the flaring bell with the right hand at the end of the tube, the player is able to lower the pitch. The amount of lowering depends upon the amount of closure, the maximum lowering which is possible by this means amounting to three semi-tones. (3) The means which is most frequently employed, however, consists in manipulating the lips. By varying the tension of his lips,—and by thus varying the vibration frequency of the blast of air emitted through them,—the player finds it possible to raise or to lower the pitch of the tone produced by the instrument. This lip-manipulation enables him to produce tones varying from b of the contra octave[3] (62 vibrations per second) to a of the twice-accented octave (880 vibrations),—a range of four octaves less one semi-tone.

Certain tones may be produced without resorting to the use of the valves. These are known as open tones; there are fifteen of them, and their pitch varies from 88 vibrations to 880 vibrations. The other tones of the instrument are produced either by the use of the valves or by partially closing the aperture of the flaring bell by inserting the hand. For instance, any open tone may be lowered by a semi-tone either by opening the second valve or by closing approximately half of the opening of the bell; open tones may be lowered by two semi-tones either by opening the first valve or by shutting off about three-quarters of the bell; and open tones may be

is also indebted to Dr. E. L. Davis (hornist), Mr. Franz Hain (hornist) and Mr. R. Nagel (cellist) of the Boston Symphony Orchestra, and to the writer's father, Mr. Frank S. Pond (cornetist).

[2] The French horn is provided with nine or more set-pieces,—'crooks' and mouthpiece extensions; when inserted at its appropriate place either in one of the coils or at the mouth-aperture, each of these set-pieces changes the pitch of the tone produced by a definite amount. These set pieces are employed only in ensemble playing.

[3] These pitches are expressed in terms of the notation of the piano scale.

lowered by three semi-tones either by opening the third valve, by a combined use of the first and second valves, or by shutting off the bell almost completely. Greater variations from the open tones,—for instance, lowerings amounting to four, five and six semi-tones such as are necessary in playing the chromatic scales of the lower octaves,—can be produced only by various combinations of the valves. These various manipulations, however, affect the quality of the tone produced by the horn; for instance, the open tones and the valve tones have a clear trumpet-like quality, while the shutting of the bell introduces a muffled quality. Hence, whether the valves or the shutting of the bell, or both together, shall be employed for determining the pitch of the tone in any given case depends largely upon the quality of tone desired, upon the accuracy of pitch variation desired, and upon the rapidity with which the passage in question has to be played,—the hand-manipulation required for shutting off the bell demanding an appreciably longer time than the manipulating of the valves.

It is clear from the foregoing statement that there are various difficulties of manipulation which must be mastered by the player of the horn. The wide range of the instrument necessitates a wide range of degrees of contraction of the lip and facial muscles. In consequence of the difficulty involved here the three highest tones and the four lowest tones of the instrument are especially avoided by players. The accurate production of the various tones demands a graduated series of degrees of compression and tension of the lips. A second difficulty in the accurate playing of the horn results from malcoördination of the finger muscles in manipulating the valves; this difficulty, however, is relatively easy to overcome. A third difficulty is involved in mastering the shutting off of the bell; it is exceedingly difficult to adjust the position of the hand with sufficient accuracy to secure exactly the desired variation of pitch and quality. Not only does the producing of any desired tone involve difficulties of technique, but the sustaining and the damping of tones likewise involve peculiar difficulties. A final difficulty has to do with tuning and playing true to pitch.

Throughout the study which is here reported, the writer has served both as experimenter and observer. His musical education has included a brief study of harmony, instrumentation and piano playing. He has had an experience extending over ten years with large and small orchestras, where he has served as trap-drummer. During the last five years he has confined his attention largely to the French horn; and during the past

two years he has played a good deal with an orchestra and in a chamber music group. His psychological training has included two years' drill in introspective analysis, in the Psychological Laboratory of Clark University.

II. *Experimental Investigation*

Among the problems selected for investigation were the following: How can one best acquire such a mastery of the instrument as shall enable one to produce any tone accurately and efficiently, to sustain it uniformly, and to damp it promptly and smoothly? We also made a study of the phenomenon of playing out of tune; of the early onset of fatigue; of the memorizing of certain difficult passages; of tuning the horn to other instruments; of the coördinating of finger-movements in operating the valves, especially with rapid chromatics; and of playing the gruppetto (or turn), trills, and slurs.

a. *Preliminary experiments.* Toward the close of the year 1914, at a time when the horn had not been played for several months, the articulation of the tones was found to be distinctly poor.[4] Instead of a clear-cut clang following immediately upon the withdrawal of the tongue from the teeth, there intervened a brief period which was characterized by a wheezing of air. The clang appeared only after an effort involving a straining of the throat muscles and an intensive pressing of the mouthpiece upon the lips. Dr. E. L. Davis had previously suggested that the player should imitate the act of spitting; and the instruction-books recommend the pronouncing of the syllable 'too' or 'tu.' Attention to the movements of the tongue, diaphragm and lips with this idea in mind, led the writer to believe that slow practicing with attention upon the production of the tones would aid in giving rise to a prompt and effective articulation of a clear clang immediately after the tongue was withdrawn. A subsequent criticism by Mr. Franz Hain led the writer to sustain the tones for a considerable period of time, and to attend not only to the attack with the movement and placing of the tongue, but also to the pitch with its variations, to the clearness, and to the damping of the tone. Mr. Hain suggested that the damping of the tone should resemble the tailing-off of the clang of a bell.

b. *General instructions and methods.* Definite periods for introspections were selected, and an order of experimentation

[4] The instruction-books which had been used were O. Langey's revised *Tutor for French Horn*, C. Fischer, New York, 1890; and H. Kaufmann's *Album of Twelve Solos*, published by C. Fischer, New York.

was arranged. The practice periods extended throughout the series from eleven to twelve o'clock in the forenoon. Instructions were as follows: "Attend so far as possible to the mental processes involved, noting their quality, duration, intensity, clearness and their sequence. Be careful to note their affective toning. Distinguish throughout between mental image and perception." The introspections were usually recorded by the experimenter himself, but in a few cases they were dictated to an amanuensis. When any process proved to be vague and indefinite, or any verbal expression proved to be unclear, the tests were repeated. The introspective reports were typewritten and filed. On the following day they were reviewed before the same problem was repeated or a new problem was undertaken. Upon the basis of these analyses, simple exercises were arranged; and these latter were practiced at periods other than those used for introspection. The progress and success of the corrective work was studied by applying tests after intervals of several days or weeks.

c. *Study of the single tone.* i. *Producing the tone.* One tone,—the open d,—offered more difficulty than any other, both in the matter of producing and sustaining. In order to study this difficulty, and if possible to correct it, exercises were undertaken in which the following instructions were employed:

a. Attempt to produce the open d, but stop at the point of releasing the tongue; do not sound the tone. *b.* Sound d at the signal of the metronome bell; introspect on the experiences associated with the producing of the tone from the fore-period until the tone becomes clear. *c.* Sound c; then slur to d; introspect. *d.* Tongue e after striking d; then slur down to d, and introspect on the experience. *e.* Play an exercise of four quarter-notes,—c, d, c, d; tongue each note; play slowly. *f.* Same exercise as *e*, but twice as fast. *g.* Play scale of f major with attention to the production of d ascending, tonguing the whole scale;; introspect especially after tonguing c. *h.* Practice scales half an hour, and then try test *e*. *i.* Slurring exercise, using *e*; follow beats of the metronome (slow movement).

The same exercises were employed with open tones c, d, and g. (These are all produced without the use of valves or hand in the bell.) Our introspections show that the following mental processes are involved in producing a single tone with tongue articulation:

When the mouthpiece was brought to the lips, the player perceived, from cutaneous pressure, that the edge of the mouthpiece pressed more intensively upon his upper lip than upon his lower lip; and he was definitely aware of muscular tension in both of his arms. When he had selected a note to be played, he seemed to hear the note, distinctly and definitely, in the form of auditory imagery. Then he perceived kinaesthetically that the muscles of his lips, chin and cheeks

were contracting; he also perceived that he was making a deep inhalation, involving movements of the diaphragm, throat, pharynx and abdomen. And he heard a hissing noise, which was immediately followed by an abrupt relaxation of the muscles of his lips, this temporal relation being conspicuously present to consciousness. The pressure of the mouthpiece upon the lips was again perceived, and simultaneously with it came a kinaesthetic perception of muscular contraction in both forearms and in the left hand. There was also a cutaneous perception of intensive pressure in the little finger of the left hand and in the thumb of the right hand. He now saw that the shadow at the base of the left thumb, between the tendons, was enlarging[5]; and he felt that the tip of his tongue was touching the lower edge of his front teeth. He was aware of changes in the pharynx and of intensive contractions of the diaphragm and abdominal muscles. Muscular tensions were present in the vocal-motor apparatus, especially in the tongue and in the soft palate, followed by a release of the confined air.

The first few introspective reports from exercises *a* and *b* with the open d indicate that the lips were frequently contracted too much, producing e instead of d; or a position was assumed somewhere between d and e, whence the tone would fluctuate ultimately eliding into the final tone. This was accompanied by an experience of disagreeableness, localized in a twitching of the pectoral muscles. The contraction of the lips was frequently preceded by a vocal-motor-auditory experience,—such phrases as 'contract,' 'pull hard,' 'away up.' This was followed by a kinaesthetic perception of a gradual movement of the lip, the lip-muscles tightening more and more, until accompanied or followed by an intensive pressure of the mouthpiece upon the lips. Kinaesthetic perceptions of muscular contractions in the arms were rare; but fragments or faint traces of these were occasionally reported. An auditory image of the note to be produced usually preceded the intensive pressure of the mouthpiece upon the lips; this image was frequently of such indefinite quality that the peculiar horn clang-tint could not always be recognized; it sometimes resembled the tone of a bell. After the first few trials of exercise *a*, the auditory image was usually lacking; but in exercise *b*, the auditory image was present throughout, and was succeeded by the withdrawal of the tongue from the teeth.

Exercises *c* and *i* were characterized by a presence of kinaesthetic images of a twitching of the lip muscles, and a kinaesthetic perception of the contraction of the lip muscles antecedent to the producing of the tone d, this perception being of relatively long duration. These two experiences did not occur

[5] This shadow serves as a warning to the player of the horn to inhibit the contraction of the muscles of the hand and arm.

with the other tones. Vocal-motor innervations frequently entered consciousness at about the same time as 'pull, pull,' together with a kinaesthetic perception of a strain of the throat muscles which persisted until the tone had become clear; soon after the tone had cleared the strain disappeared.

In exercise *e* the slurred tones were produced without tongue articulation, with a constantly moving column of air. In the early trials it was found to be quite impossible to sustain the open d at all,—almost as soon as it was sounded it would suddenly change to e; and the same experience occurred in descending,—*i.e.*, the tone elided into c before the d had become clearly articulated. It seems apparent that the learner had not yet acquired a proper position of the lips for sustaining a tone between c and e.

Exercise *h* indicated that the duration of the contraction of the lip muscles had been increased. After practicing scales for half an hour, it was found to be more difficult to contract the lips to the position required to produce the open tone. There was less inclination to effect the d, a disinclination to continue the effort. A more intensive and sudden movement of the diaphragm was also noticed when attempting to produce the d. A contraction of the arms and an intensive pressure upon the lips were also reported.

In all of the exercises which involved tonguing, there was reported an auditory perception of hissing which increased in intensity but which ceased abruptly when the tone made its appearance. A cutaneous perception of the tongue touching the gums above the upper front teeth was occasionally reported, as also was a straining of the muscles of the throat. Practice before the mirror furnished a check and a confirmation of the introspections.

A subsequent series of exercises dealt with the formation of the lips for the producing of the open d as a clear tone, with an efficient articulation with the tongue, and with the producing of a clear tone without the tongue in the slurred passages, the muscular strain in the throat being avoided. In these exercises, brief passages of open tones in that portion of the scale most easily within reach were played slowly, with a view to attending to first one and then another of these various factors.

A brief series of exercises was undertaken where the mouthpiece was detached from the horn and used alone; here the procedure consisted in imitating the act of spitting, and in placing the tongue carefully between the front teeth. Some of this practicing was done before the mirror, in order to

assist in discovering a position of the lips which would be favorable to the production of d and would avoid the straining of the throat muscles. Another part of this corrective practice consisted of exercises which involved the sustaining of notes where the intensity of the tone was increased without alteration of its pitch.

When the same exercises were repeated a year later, the introspections indicate that there had been a marked improvement in the lip adjustment and in the supporting factors. Straining of throat muscles is now rarely present, excepting with exercise *h*. Tonguing is more clear-cut and habitually from the edges of the teeth; in higher notes, at the teeth; in the lower notes, slightly between them. No hissing is now observed except under conditions similar to exercise *h*, and in attacking a low note immediately after a high note. There is no longer any intensive pressure upon the lips; and excepting in cases of the highest notes, no enlarging shadow between the tendons at the base of the left thumb (which serves as an index of the presence of an undesired contraction of the arm and hand). The lip muscles appear to move by quick short jerks, especially between c, d and e. Auditory images usually appear before the first note of a passage, especially with such exercises as *a* and *b*. Affective toning of agreeableness is frequently present, with a vocal-motor-auditory innervation of 'fine' and a kinaesthetic perception of stretching the body as if to rise upon the toes or to jump up and down. This occurred in a similar form in exercise *h*, when the passage was accomplished recently without apparent exertion.

ii. *Damping the tone.* A study of the player's technique in damping the tone first revealed the habit of pressing the tongue firmly against the teeth. In consequence of this procedure the tone was cut off abruptly; instead of tailing off gradually like the fading sound of a bell, the tone had a blunt and rough ending. This led the writer to undertake a detailed study of the process of damping; we arranged a series of twenty-one experiments which attacked the following problems: *a*, stopping the tone by means of the tongue; *b*, an attempt to produce in the horn-tone such a gradual tailing-off as is characteristic of the fading clang of a bell; *c*, the damping of sung tones; *d*, the damping of spoken syllables; *e*, the damping of staccato passages with the horn.

The experiments under *a* involved simple exercises of the open tones of the scale of c, and were of two forms. In one series, the tone was damped by pressing the tongue between the teeth; in the other series, the middle of the tongue nearly

touched the roof of the mouth. This latter method of damping had been suggested by an observation of the act of pronouncing the syllable 'ku' in the triple tonguing of the cornet, the tonguing being similar to that which is present in the process of pronouncing 'tu, tu, ku.' Our experiments indicated, however, that no such means of damping could be utilized in horn playing; the method is tedious and difficult, and the effect is distinctly unmusical.

The *b* and the *e* series of experiments were of similar nature; but in the latter the tones were damped shortly after enunciation while in the former they were held until it was nearly time for the next note. Introspections at the outset here revealed some contraction of the throat muscles, a movement of the tongue upward and forward, and a sudden interruption in the diaphragm described as a 'hitch' in the region near the ensiform cartilage. The larynx was involved, the experience being described in the introspections as resembling swallowing. Introspections where the tone was struck immediately after damping, then damped and immediately struck again, report the presence of an extreme movement of the tongue 'from the back of the mouth' to 'touching the teeth;' it seems probable, however, that two movements occur here,—that of the base of the tongue and that of the free portion. The writer believes that the tongue is relaxed to the floor of the mouth where it lies almost flat, from which position it is extended so that the tip touches the teeth. Hence it seems to move a greater distance than it does.

It seemed probable that a study of the procedure ordinarily employed in the damping of sung tones and in the damping of spoken syllables would throw light upon the question as to what is the best procedure to follow in damping the tones of the norn. Accordingly we arranged two series of experiments; in a first series the player was asked to sing 'do,' to sustain it during two beats of the metronome, then to damp it, and describe his experience; to sing 'dee,' sustaining it for a time, finally damping it and describing his procedure; to sing 'too,' sustaining, damping, and reporting as before; to sing 'ha, ha, ha,' rapidly, attending especially to the conclusion of each syllable. In the experiments with spoken syllables, he was asked, successively, to pronounce the syllables 'I,' 'be,' 'bud,' 'bug,' 'too,' 'took,' and in each case to describe his experience especially with regard to the conclusion of the syllable.

The introspective descriptions obtained from these experiments show that one is distinctly aware of movements of the diaphragm and of the pharynx when one proceeds to damp

sung tones and spoken syllables; and these introspections indicate that these diaphragmal and laryngeal movements probably give rise to the damping of the tone. In consequence of this finding we arranged a series of exercises where an attempt was made to throw the bulk of the damping upon the diaphragm, and to concentrate attention upon the factors involved These exercises, which were played upon the horn, were practiced regularly for a period of three months; and they were subsequently resumed after an interim of nine months. The notes contained in these exercises were separated by an interval of an octave or a sixth, this magnitude of interval necessitating considerable time for lip adjustment, and hence affording a favorable opportunity for observing the procedure employed in damping. Practice before a mirror showed that at the outset, the tongue, the larynx and the pharynx were actively concerned in the process of damping; but by appropriate variations of our exercises we succeeded within six weeks in reducing the movements of the tongue and the larynx to a minimum.

And when after an interval of nine months the exercises were resumed, with special observation of the damping of staccato and legato notes, it was found that considerable success had been achieved within that portion of the horn-scale which is most frequently employed. The transition from a high note to a lower note over an interval of an octave is now accomplished by a rapid and accurate lip adjustment and a clear-cut tongue movement in the articulation. The tone is sustained without difficulty, a contraction of the diaphragm being maintained with no strain of the throat muscles. It is now possible to damp staccato notes with a rapid but gradual diminution of intensity; the damping of legato notes is less perfect.[6] It seems that the slight change in the pressure of the air by a momentary interruption of the contraction of the diaphragm has not yet been attained. Tones in rapid passages appear at the present time to be quite continuous, without interruption in the diaphragm; in slow passages a distinct damping is perceived.

d. *Study of the tuning process.* i. *To acquire accuracy and facility in playing tones true to pitch.* It had been observed during orchestra rehearsals that the playing of certain passages was not always accurate with regard to pitch. This was especially noticeable in the case of e-natural, which was fre-

[6] The writer's interpretation of a legato tone is one which is tongued very softly, and with a slight but barely audible diminution of intensity.

quently played somewhat flat. A series of tests was undertaken to determine whether the fault was due to a defective pitch discrimination, to a lack of appreciation of intervals, or to a neglect of some of the elementary factors known to be essential in the production of single tones.

This series of four tests was made in October 1915; corrective exercises were then begun and continued until December 1915, when the tests were then undertaken. These tests have been repeated (January 1917,) in order to determine whether any improvement had resulted from the corrective exercises. The instructions of the tests were:

a. Strike e-natural (in the absence of any other source of pitch). *b.* Play the scale of e major in ascending order; tongue e, then e of the next octave higher; introspect especially from the time of the attack upon the lower single note after playing the scale. *c.* Strike c; slur to d; then to e.* *d.* Tongue d, d-sharp, e, e-flat and d in slow succession.

The results of these tests indicated that the inaccurate playing was not due to a defective discrimination of pitch or of intervals, but to a defective adjustment of the player's lips, in consequence of which the note was flatted. The player succeeded in producing e accurately from memory, when instructed to do so. It seemed obvious that his flatted e could be sharped enough to make it a true e if only the pressure of the mouthpiece could be eliminated. A practice series was undertaken with this in mind for the twofold purpose of allowing an auditory image either of e or of d to function, and of allowing the player to attend to it and to bring his note into unison with it if possible.

After these exercises had been continued for a few weeks it was found that e could then be produced without great effort and with satisfactory precision. Intensive pressure upon the lips is now (February 1917,) entirely absent.

ii. *Tuning to another instrument.* This problem was investigated at about the same time as the foregoing. It had been observed that in case of a slight difference in pitch,—horn and piano, for instance,—the player was sometimes in doubt as to whether the notes of the horn were sharp or flat. In order to throw light upon this phenomenon the following exercises were devised:

a. Sound middle c on the horn; sustain it until after its equivalent on the piano has been sounded, and long enough to judge whether the clangs are alike or not. *b.* After the f on the piano has been struck and the clang has died away, tongue c on the horn. *c.* Tongue e (the usual tuning note with orchestras); let the clang die away;

the equivalent on the piano will then be struck; after it has died away, report on the whole experience.

These were subsequently supplemented by a series of daily exercises which were designed to afford practice in distinguishing slight differences of pitch, and in determining whether a given horn-note was sharper or flatter than a piano-note. The conditions of these exercises were analogous to those of *b* in the above list, which involved a concentration of attention upon the fundamental tone of the piano-note.

It was found that when the difference in pitch (horn and piano) was less than a quarter-tone it frequently failed to be detected; differences amounting to a quarter-tone were always detected, but the auditor was sometimes uncertain as to the direction of the difference,—*i.e.*, as to whether the horn was sharp or flat. The perception of the fundamental tone of any given piano-note or horn-note was frequently found to be vague and indefinite, under the conditions of these experiments.

The investigation of the tuning process was extended to include tympani and piano, the procedure here being similar to that followed in the case of the horn and piano.

Here again it was found to be impossible to distinguish slight differences of pitch when the two instruments were sounded simultaneously. It was discovered that tuning was facilitated when the octave of the drum-note was struck upon the piano; the first over-tone of the drum-note was readily perceptible with each tap of the drum-head. It seemed to make no difference whether the drum-note was struck before or after the piano-note; in either case the auditor was able to distinguish minute differences of pitch but he was not always able to reach an immediate judgment as to whether the drum was sharp or flat. An auditory image of the piano-note and a tentative humming of the note accompanied the subsequent adjusting of the drum-head screws. When this adjusting had been completed, the over-tone of the drum meanwhile being brought into unison with the imaged or hummed piano-note, it was found that there was little, if any, difference in pitch between the piano and the drum. These results indicate that the auditory or vocal-motor image may serve as an accurate means of tuning.

e. *Manipulating the valves of the horn: a study of motor coördination.* It had been observed in a number of runs that the pitch-difference between a and a-flat seemed to be greater than that between a-flat and g in the descending scale. A closer examination of this phenomenon, however, indicated that the pitch-differences were not objectively unequal but that an illu-

sion of inequality of pitch-difference resulted from the fact that a longer time was required for depressing the a-flat combination of keys than for depressing the a combination. The a-flat combination is operated by the second and third fingers; the a combination, by the forefinger and the second finger. The reaction-times of the various fingers were measured by means of a Sanford vernier chronoscope, when the following averages were obtained (results are expressed in sigma or thousandths of a second): forefinger, 160 sigma; second finger, 210 sigma; third finger, 270 sigma; forefinger and second finger in combination, 210 sigma; second and third fingers in combination, 360 sigma.

These findings show that the coördination of the writer's second and third fingers is decidedly poor, notwithstanding his year of piano practice, and notwithstanding his frequent use of a typewriter and a comptometer. This defective coördination proved to be a handicap in the performing of horntrills which involved these fingers, especially in combination. A series of exercises with trills and a form of gruppetto (or turn) involving a and a-flat were practiced five minutes daily for several weeks. Three weeks after this practice was begun, the original tests were repeated. At this time it seemed wholly impossible to depress the second valve and then to alternate the first and third valves in time with the metronome (eighty beats per minute). After a few notes had been played, the third finger would lag behind, or the second finger would move with it; in consequence of this, split tones resulted, or the metronome struck before the tone had been produced. The difference in reaction-time was now of about the same magnitude as before,—forefinger, 140 sigma; second finger, 200 sigma; third finger, 260 sigma; forefinger and second finger together, 210 sigma; second and third fingers together, 370 sigma.

Practice was continued, somewhat irregularly, for an additional period of three months; and the tests were again repeated. It still proved to be impossible to hold the middle finger down consistently and alternate the movement of the other two. All went well for a brief period, but after that the middle finger began to accompany the movement of the third finger. The combination of first and second valves required practically the same amount of time as the second and third valves. Experiments with the metronome indicated no difference; the movements a, a-flat, g, g-sharp, a, etc., were in unison with the beats over a period of one minute. The chronoscope showed no essential change from the preceding test.

III. *Summary*

Of the difficulties selected to be studied, those which are reported are involved in producing, maintaining and damping a single tone, in playing single tones on the horn true to pitch, in tuning to another instrument, and in coördinating the fingers which operate the three valves. With the aid of introspective analysis, it has been found to be possible to diagnose difficulties in the production of the single tone, to correct a faulty habit of tongue placing, and to articulate the tone efficiently and accurately immediately after the tongue is withdrawn. With regard to the damping of the tone we have found it to be possible to make a partial analysis of the process, but not to analyze it completely. It appears to be practicable to damp the tone far away from the mouthpiece, at the diaphragm, interrupting the outward flow of air at the source of pressure. This enables the player to approximate the fading clang of a bell, although the fading of the horn-tone is less gradual. This device provides a damping which is of considerable value in musical passages involving especially staccato and legato notes. In the limited scope of the exercises described in this investigation, the art of producing legato notes has not been completely perfected. It was observed, however, that a diaphragmal damping was effective in spoken syllables and sung tones. In our study of playing the horn true to pitch, our introspections indicated that while auditory images play a part, they do not function extensively. In the case of one tone played below pitch, it was discovered that the difficulty was due to a too intensive pressure upon the lips, which prevented a sufficient contraction of the lips; this difficulty was overcome during the investigation.

Tuning of the horn to the piano was materially aided by attending to an auditory image if the piano were struck first; when the horn-tone was struck first this proved to be impossible. Slight differences in pitch could not be distinguished when the horn and the piano were sounded simultaneously; and this was also true in the case of the tympani and piano. In tuning the kettle-drum, the auditory image functioned but was accompanied by a humming of the piano-note. The hummed note was compared with the first over-tone of the drum-note as the drum-head was tapped in tuning; the pitch of the hum did not suffer materially in the tuning process. And finally, introspections and a chronoscope served to locate a difficulty in the muscular coördination of the valve fingers; and when the difficulty had been located, subsequent practice led to a decided improvement of the player's technique.

IV. *Conclusions*

These experiments show that introspective analysis, by a trained observer, may be of service in the study of instrumental music. They indicate that the mental processes involved in learning to play a musical instrument are complex and intricate; that the detection of errors of technique may be aided by attending to these mental processes, and that an improvement of the technique of instrumental music may thus result from an efficient employment of the method of introspective analysis.

Our investigation shows that an additional tool is available to the student of musical pedagogy. The student who has a sound knowledge of general psychology and who has been trained in the use of the methods of the psychological laboratory finds himself in possession of an equipment which gives him a distinct advantage in the study of musical technique.

FUNDAMENTAL THEOREMS IN JUDGING MEN.

By EDWARD L. THORNDIKE, Teachers College, Columbia University

The judgments of men with which we are concerned are judgments of the man's fitness for some defined purpose. Such are the judgments by a life insurance company of a man's fitness to be insured, or the judgments by an examining board of a boy's fitness for entrance to college, or the judgment by an employer of a man's fitness for a certain job, or the judgment by a recruiting officer of a man's fitness to be a soldier. The theorems to which I ask your attention concern the amount of weight to be attached to any given fact or combination of facts about a man in making such judgments. Our problem is the abstract one of the general theory of weighting facts about a man and of using them conjointly to influence the judgment of his fitness. The theory will be illustrated from time to time by particular examples, but you should not let either the merits or defects of these distract you from the abstract issue to which they refer.

Consider first the case of a job, fitness for which is assumed to depend upon five facts *a b c d* and *e* and only these five.

a being the amount of He which the man possesses,[1]
b being the amount of Ho " " " "
c being the amount of In " " " "
d being the amount of Co " " " "
e being the amount of K " " " "

CASE I.

Using J to mean the amount of fitness of a man for the job, assume that any increase in He produces a proportional increase in J, as shown in Fig. 1.

Assume similarly that any increase in Ho, In, Co and K produces a proportional increase in J, each acting independently regardless of the amount of any other one of the five.

[1] If it aids memory for these symbols, the reader may think of He as health, Ho as honor, In as intellect, Co as ability to command men, and K as technical special knowledge and skill, but the case is to be argued in entire abstraction from any facts not stated in the assumptions.

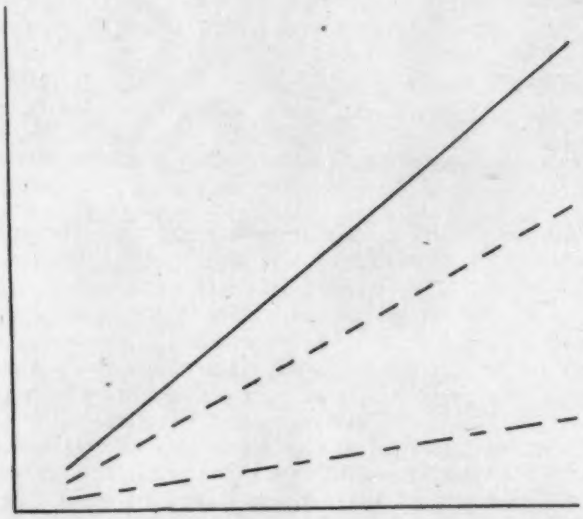

FIG. 1.—Specimens of rectilinear relations. Amounts of the symptoms are scaled from left to right. Amounts of J are scaled from the base-line up.

Then we can estimate by how much one man is superior to another in J if we know the amounts of He, Ho, In, Co and K that each has, and know the slopes of the relation lines for axes scaled in defined amounts of J and He, Ho, etc. We arrive at a man's status in J by adding the amounts of J he has by reason of whatever amounts of He, Ho, In, Co and K he has. If, in respect to production of increase in J, one unit of He = 1 unit of Ho = 1 unit of In = 1 unit of Co = 1 unit of K, it suffices for all practical purposes of selecting for J to add He, Ho, In, Co and K. If 1 Ho is of more importance than 1 He, that is, produces a larger increase in J (say 1.7 times as large), it suffices for all practical purposes to multiply the man's amount of Ho by 1.7 and then add. That is, when increments of the symptoms of J produce proportional increments in the thing to be selected for, we select by adding the amounts of the symptoms, these having been weighted by multiplying each by a constant which is expressive of the number of units of J produced per unit of He, Ho, etc., respectively.

This assumption of proportionality or rectilinearity in the relation line is behind most of the scientific work that has been done with educational and vocational selections. The technique of partial correlation coefficients and the regression equation,

for example, assumes approximate rectilinearity of the relation lines.

CASE II.

Assume the same independence of influence as before, and assume that each increment of He, Ho, etc., increases J, but do not assume proportionality between the increments of He, Ho, etc., and the increments of J. We then have an infinite number of possible relation lines, a few of which are shown in Fig. 2.

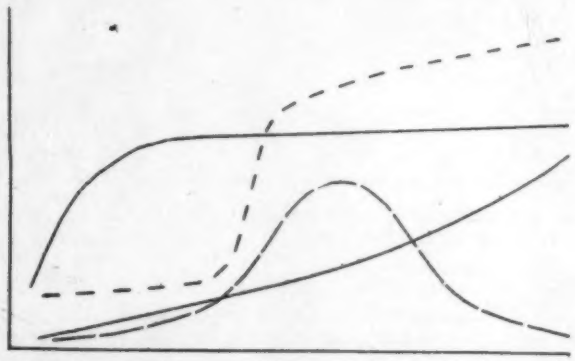

FIG. 2.—Specimens of non-rectilinear relations. Scaling as in Fig. 1.

Certain cases deserve special attention. For example observe Fig. 3a where the same increment of a symptom pro-

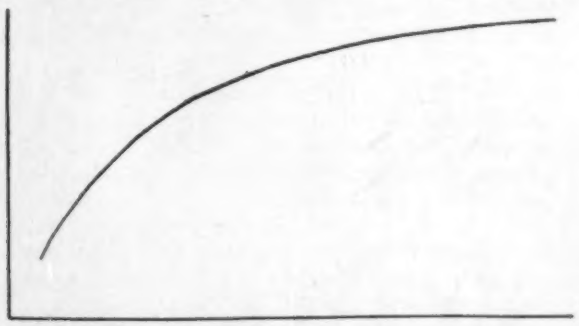

FIG. 3a.—A relation whereby successive increments of the symptom produce smaller and smaller increments of J. Scaling as in Fig. 1.

duces less and less effect on J according to the amount of the symptom already present. Such might be the case with health and strength in the case of fitness for a job as a law-clerk or

stenographer or teacher, for example. One step up from invalidism might mean much more gain in fitness than an equal step up from a robust and athletic level.

In Fig. 3b we have the converse case where a given incre-

FIG. 3b.—A relation whereby successive increments of the symptom produce larger and larger increments of J. Scaling as in Fig. 1.

ment does not amount to much unless it is an addition to already fairly large amounts. So, for example, the semi-interquartile range, or median deviation, of musical ability, when added to zero, would be of nearly zero value as a sign of fitness for employment as a soloist; but the same amount, when added to the ability of a second-rate performer worth $4 an evening, might make him worth $400 an evening.

In Figs. 4 and 5 we have the case of a quality which suddenly rises in value as a symptom from nearly zero to nearly its maximum.

It is very hard to find cases of intellectual or moral or economic qualities in men which are related to any important variety of fitness after the fashion of Fig. 4 or 5. Indeed it is hard to find important physical qualities which are. Yet the existence of such a relation is the only justification for an enormous number of widespread practices in selecting men as fit for suffrage, for life insurance, for entrance to college, and for the army and navy. Wherever a certain line is drawn as to weight per inch of height, temperance with alcohol, liability to heart disease, length of education, or the like, all those below the line being given equal credit (usually in the form of 'failed,' 'rejected,' 'unsatisfactory' or the like) and all those above the line being given equal credit (as 'normal' or 'passed' or the like), this single perpendicular-step relation is pragmatically assumed.

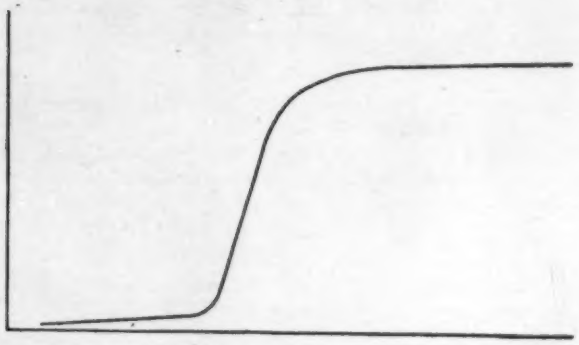

FIG. 4.—A relation whereby successive increments of the symptom produce almost zero effect save at one short interval of the scale. Scaling as in Fig. 1.

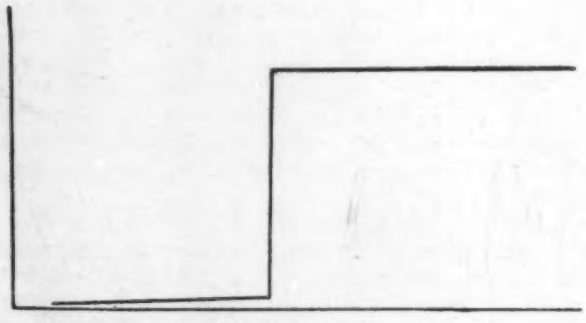

FIG. 5.—An extreme case of Fig. 4.

It may be wise, for certain legalistic reasons and for convenience in making and recording decisions, to cut the whole range of variation of a quality into two sections, crediting all amounts in one section as 0 and all amounts in the other section alike. It should be understood, however, that the procedure is almost the worst possible so far as concerns selecting the best quota of men. Only a failure to use the symptom at all or a negative use of it could be worse. For a line of zero slope, perpendicular slope, and then zero slope is an extremely poor fit for any of the relation lines in question. It is least objectional in cases of infection, as with malaria or syphilis.

How inefficient it is may be realized pictorially by Table I where the total credit really due two certain men is contrasted with what they receive by the "perpendicular" or "all or none"

treatment. A similar inefficiency, though not so great a one, *must always* occur, the error being statistically that of excessively coarse grouping.

TABLE I—SIXTY BEING REQUIRED TO PASS, PASSING BEING REQUIRED IN NINE OUT OF TEN TRAITS

	Individual A	Individual B
Trait I	62	92
" II	64	88
" III	65	85
" IV	63	90
" V	49	49
" VI	65	52
" VII	66	86
" VIII	61	94
" IX	70	83
" X	62	87
Av.	63 passed.	81 failed.

It is beyond the scope of this paper to balance this loss in efficiency in selecting the right man against the inconveniences of measuring each symptom along a linear scale, weighting it according to its relation line and combining weights by addition. The inconveniences are often great, but I am decidedly of the impression that the inconveniences resulting from failing to get the best possible selection of men are as a rule many times as great.

The failure to use a scientific procedure is not so much due to apprehension of its real difficulties as to ignorance of its merits and the assumption of demerits which do not exist. Custom and language mislead us into treating a continuous distribution of variations as if they fell into sharply distinct groups, legal requirements in particular often exacting such clefts. The insecurity of fine grouping, and the lack of knowledge of precisely the best weights to attach, are assumed to be demerits which coarse grouping and zero or constant weights avoid. They do not avoid them.

Of whatever sort the relation line may be, the procedure is still (so long as the symptoms exert their influence independently) to attach weights and add. The difference from the first case of proportionality is that each separate increment of each symptom now may need its separate multiplier.

CASE III.

Consider now the case where certain traits seem superficially each to produce an effect upon fitness for a job, but where really their value lies largely in a common element. Thus

suppose that being born from the professional classes correlated to an extent of +.5 with success as an army officer, that length of education so correlated, that standing in class so correlated, that score in examinations at the training camp so correlated. Suppose that we have a thousand men ranked in these respects and also in ability to command men, which we will suppose also correlates +.5 with success as an army officer. The first tendency of a superficial thinker is to assign equal weight to each of the five traits. But if, as is likely, the first four intercorrelate closely, being related by a common element, say intellectual capacity, whereas power to command men correlates much less with their sum, the last should be given much more weight than any of the first four. To prevent all such errors we use either an experimental analysis or the technique of partial correlation.

The fundamental theorem in question may be stated as: Do not weight the same contributing element twice because it appears in two or more traits. Or, more adequately; Attach weights to elements according to the amount of their contributions, irrespective of the number of symptoms in which they appear. A full determination of independent elements and their contributions, whether experimental or by the method of partial correlation coefficients, is very difficult, and has never been made in any case, to my knowledge. A complete determination is indeed not necessary for fairly efficient prophecy. Where the best possible weighting would prophesy fitness with say, a resemblance to demonstrated fitness of .95, a prophecy to the extent of .90 will commonly be reached by such a rough weighting as a competent thinker can devise in an hour or two upon inspection of the relevant correlations. So for practical purposes, we may translate the theorem into: Attach weights to traits only after knowledge of their intercorrelations.

Case IV.

Consider now the case where a symptom's amount of influence depends upon not only the amount of the symptom itself, but also the amount of some other symptoms. For example, suppose that each increment of intellect (In) contributed 3 J, that is, 3 units to fitness for a certain job, if only a certain low degree of honor (call it 5 Ho) characterized the man, but that the same increment of intellect (In) contributed much more J if the man was twice as honorable (10 Ho). Or, more precisely, let the relation of intellect (In) to fitness (J) be line *a*, when honor (Ho) is 0, line *b* when honor (Ho) is

1, line *c* when honor (Ho) is 2, line *d* when honor (Ho) is 3 or more as shown in Fig. 6. In such a case the amount of In

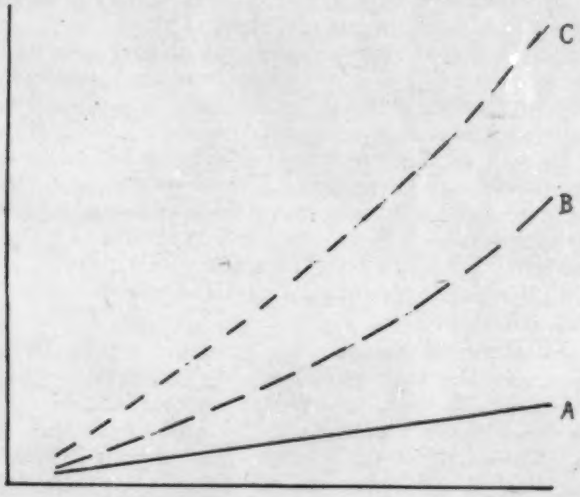

FIG. 6.—A relation whereby the amount of J produced by some factor depends also on the amount of some other factor. A, B and C are three different relations between a factor and J, depending on the amount of a second factor.

is obviously to be multiplied by a factor proportional to the amount of Ho in addition to all other weighting of In.

The dependence of the amount of influence of a trait upon the amount of some other trait possessed by the man will often be more complex than that described in the illustration. For example, the value of technical knowledge and skill for a certain job might vary as the square root of the man's intellect or as the square of his intellect. There may also be many sorts of irregular relations in these dependencies of one trait's influence upon the amount of another trait that is possessed.

I am not aware that any scientific investigation has measured any of these dependencies. There is, however, good reason to believe that they exist and are important. A man's possession of what we call energy, for example, seems to be a multiplier for his intellect or skill. A man's loyalty or devotion in any particular job seems to be a multiplier of his other equipment for it. What we call roughly interest in success, or determination to succeed, or ambition, seems to be a multiplier for energy. And in theory, at least, we must admit it as a fundamental theorem that prophecy of the degree of influence

of any amount of trait requires consideration of the amount of every other trait in the man in question.

There are other principles concerning the use of facts in the selection of men which must be followed to make the best possible prophecy, but limitations of time prevent their discussion now. In the time that remains I may simply summarize our findings roughly and compare the scientific with the impressionistic or intuitional use of facts about a man.

We have seen that the status of a man in the traits relevant to fitness for a job may be expressed in an equation:—John Doe $= 7a + 9b + 4c + 21d$. . . . A prophecy of his fitness relative to other men is obtained by attaching weights to a, b, c, d, etc., in view of (1) their relations to fitness, (2) their partial constitution by common elements, and (3) any dependencies whereby one gains or loses in influence according to the amounts of the others which are present. The setting up of an equation of prophecy from an equation of status will usually be very complex, but a rough approximation, if sound in principle, will often give excellent results. In so far as the lines of relation, interrelation, and dependency are rectilinear, the technique is greatly simplified; and a rough approximation to this is probably often the case.

Even when approximations are used and when, by good fortune, many of the relations concerned are rectilinear, sound procedure will still be more elaborate and difficult probably than has ever yet obtained in practice. Practice is thus justified to some extent in judging fitness experimentally by tests with dummy operations like those of the job in question, as well as analytically by a weighted combination of contributing elements.

All this study of relation lines, intercorrelations, facilitations and inhibitions and resulting weights by multiplying and adding, represents a scientific execution of just what the competent impressionistic or intuitional judge of men tries to do. The strength of such intuitional judgments in comparison with the formal systems of credits and penalties of the past has been, not that the intuition was less quantitative, but that it was more so! The formal systems of the past have used symptoms merely additively and often with only an "all or none" credit. They have not allowed for the undue duplication of credits by intercorrelations, and have not sensed the importance of the multiplying effect of certain traits upon others. The competent impressionistic judge of men does respond to these interrelations of the facts and sums up in his estimate a consideration of each in the light of the others.

If there are ten traits involved, say ten entries on an application blank, he may be said to determine his prophecy by at least $10+9+8+7+6+5+4+3+2+1$ quantities, since he responds to each trait in relation to all the others. There is a prevalent myth that the expert judge of men succeeds by some mystery of divination. Of course, this is nonsense. He succeeds because he makes smaller errors in the facts or in the way he weights them. Sufficient insight and investigation should enable us to secure all the advantages of the impressionistic judgment (except its speed and convenience) without any of its defects.

A PLAN FOR THE TECHNICAL TRAINING OF CONSULTING PSYCHOLOGISTS

By L. R. Geissler

The rapid progress which applied psychology has made in recent years, and especially the services which it is rendering in the present national crisis, are turning the eyes of its supporters towards the future in an effort to determine, on the one hand, the best means of making the results obtained by scientific investigations available to the various fields of human endeavor and, on the other hand, to protect the unsuspecting public against the exploitations of pseudo-psychologists. The latter have quickly recognized the great possibilities of applied psychology, especially in the fields of business, vocational aid, and mental hygiene, and though possessing little or no psychological training, they have acquired sufficient psychological vocabulary to supplement their oratorical or literary gifts. Some have even gone so far as to gather a large number of empirical observations upon which to base semi-scientific systems of mental aids for business, character or occupational prognosis, and similar purposes, and in some instances are known to have made, intentionally or unintentionally, exaggerated claims of accomplishment. It is evident that such people hurt the cause of applied psychology more than they help it. In order to draw a sharper line of distinction between them and the academically trained applied psychologists the latter will sooner or later be driven to adopt some professional badge or means of exclusion similar to those existing among other academic professions and highly trained specialists. This seems the more desirable as the term psychology has always been misunderstood and misapplied by writers and laymen alike, and a continuance of such misuse will work the greater harm, the more widely the term psychology is being employed.

Concerning the other question of determining the best means for making the results of applied psychology most readily available to the concrete problems of everyday life we may refer our readers to Hollingworth and Poffenberger's recent book on *Applied Psychology* which in the last chapter discusses the future of applied psychology. Here the authors point out that "in the application of any science to the concrete pur-

poses of practical life some adjustment of existing machinery or the development of some appropriate institution or professional avenue must always be made." Then they show that "in the case of chemistry the method has been established of placing the scientifically equipped worker in the midst of the industrial plant, providing him with adequate means of research and definitely setting for him the nature of the problem with which his research has to deal . . . . . In the case of physics there has developed an entirely new professional group, the engineers . . . . . In the case of psychology neither of these two methods of adjustment has as yet been widely adopted, although tendencies in both directions may be observed." After discussing three other types of adjustment of a more or less unsatisfactory and temporary nature, the authors come to the conclusion "that the solution of the immediate future in applied psychology will be similar to that commonly adopted in the case of applied chemists, bacteriologists, etc. It is to be expected, however, that in time the rapid development now going on in applied psychology will make necessary the engineering type of psychotechnic expert, the consulting psychologist."

There seems to be no question that this new profession of consulting psychologists has passed its incipient stage, and has fair prospects of permanently establishing itself amongst us. Its initial successes are undoubtedly due to the fact that it is counting among its earliest and most active members some of the foremost psychologists of the country. If we are right, then, in predicting an increased demand for technically trained consulting psychologists, it becomes our duty to provide a supply which shall be adequate both in quality and in number. In the writer's opinion this problem may be solved in a way which at the same time offers a solution of the other problem of eliminating the self-styled psychologists mentioned above. The plan proposed here consists, briefly, in standardizing the term "consulting psychologist" and permitting nobody to use it except those who have had a certain amount of technical training certified to by a collegiate degree. But before requesting higher institutions of learning to confer the title of "consulting psychologist" upon certain of their graduates, analogous to the present custom of giving teachers' diplomas and similar distinctions, it seems necessary for psychologists to agree upon a more or less uniform plan for the future collegiate training of such men and women as are to be admitted to this new profession.

With a view of more quickly accomplishing this aim, the

writer has submitted below a tentative plan for the uniform training of consulting psychologists, in the hope that it will arouse a widespread discussion and ultimately lead to some definite results. The present plan involves both a qualitative and a quantitative differentiation. The latter consists in providing three titles, parallel to the bachelor's, the master's and the doctor's degree, namely, "assistant consulting psychologist" (A. C. P.), "consulting psychologist" (C. P.), and "expert consulting psychologist" (E. C. P.). The qualitative differentiation consists in a special training in certain branches of applied psychology,—medical, educational, industrial or the like. In the following discussion the writer has placed greater emphasis upon the undergraduate training, because here the question of uniformity seems the more important and more pressing. This is especially true of the first three college years, before any pronounced qualitative specialisation is to be undertaken. The proposed plan is based upon the customary collegiate units of fifteen credit hours per week per year, or the completion of sixty credit hours for graduation.

In the first year a student should be required to take a three-hour course in English, where composition in technical language, the making of briefs and outlines, and the summarizing or reviewing of technical literature should form a considerable part of the content of the course. Another three-hour subject is mathematics which in many cases may not need much modification from the traditional contents of such courses. A third course should be in general sociology, in which the student is to be introduced to the manifold problems of human society, with special emphasis upon such topics as demand and supply of labor, crime and institutions of correction, systems of civic and other forms of government, social and charity work, methods of caring for defectives, and the like. If the freshman has had no modern languages before entering college, he should now take a three-hours beginners' course in French and also in German. If, however, he has had at least two years of either or both in high school, he should now take an advanced course in that same language.

The sophomore year is to continue the elementary foreign language work with advanced courses. Where, however, such an advanced course was taken in the freshman year, it may now be followed by a general introductory course of three hours in such subjects as commerce, education, law, hygiene, genetics, or others. In addition, elementary courses in physics and biology of at least three hours each and preferably including some laboratory work are to be required. (The customary

substitution of at least two hours of laboratory for one recitation hour of credit is here accepted.) Finally, the sophomore year is to include an introductory or elementary course in general psychology of three hours, which is to be of the nature of a general survey of the whole field of psychology and its various branches, but without reference to any particular system of psychology, although some emphasis should be laid upon the study of the normal adult human mind. This course need not involve any laboratory work, although experimental demonstrations before the whole class are desirable.

In the junior year I would require an introductory course in general psychology of three hours throughout the year, in which the student is to become acquainted not only with the most important ancient and modern systems of thought, but also with the general content of such other philosophical disciplines as logic, ethics, aesthetics, metaphysics, etc., in order to give him a better understanding of the various mental sciences and their intimate relations to psychology and to prevent him from falling into the errors of psychologism and false hypostatisations. There is to be offered a full year's course in theoretical psychology of a more advanced nature, familiarizing the student with various systems and theories and introducing him to the original sources. This course should be paralleled by a laboratory course of at least six hours a week (three credit hours) in which the student is to become familiar with the experimental work in sensation, perception, reaction, attention, association, introspective analysis, Weber's law, the quantitative methods, and related topics. A two-hour course should be equally divided between the translating of French and German psychological texts, in correlation with the theoretical course. A one-hour course (to supplement the two-hour language course) is to be offered in statistical and other advanced mathematical methods, partly to correlate with the experimental work and partly to be preparatory for the senior year work in mental measurements. The remaining three hours may be left either as general electives or else taken up by such general introductory courses as were permitted to take the place of French or German in the sophomore year. It is assumed that the work of the first three years of college as outlined above can be offered by any standard college in this country with a moderate equipment for a psychological laboratory.

In the senior year the first qualitative specialization is to begin; as the student is now required to make a definite choice among the various fields to which psychology is at present being

applied. He is to take a general survey course of three hours in applied psychology which is to offer an outline of the whole field of applied psychology, its scope, aims, methods and results. This is paralleled by a laboratory course in mental measurements and tests, of six hours weekly, and is to give him an opportunity to learn to conduct the tests on other individuals. The remaining nine hours are to be divided among a major subject of two courses and a minor subject of one course of three hours each. The major and minor are to be selected from the following groups of topics: A, Commerce, including journalism, marketing, manufacture, management, advertising, and the like; B, Law, including pleading, evidence, general criminology, penology, sociology, and others; C, Education, including teaching, administration, supervising, educational measurements, vocational guidance and selection; and D, Mental Hygiene, including psychiatry, neurology, psycho-analysis, psychotherapy, and similar topics. It is expected that a student will select for his major and minor groups such courses as stand in close relation with each other. These courses are to be of a more advanced nature than similar ones taken in previous years, and are understood to be offered by specialists in these lines, except perhaps in some courses included in the last group, which might be offered by members of the psychological department.

It is evident that the variety of courses included in the four groups is not likely to be found in the curriculums of many of the smaller colleges; and it is even questionable whether any institution should make an effort to offer all these courses. For, if a student has decided upon a certain combination of subjects for his major and minor, he need only transfer his college work to that particular university which offers him the best opportunities of studying these subjects. The uniform preparation during the first three years of college work should greatly facilitate such transfers; and the possibility of limiting the work of specialization to a few universities which have greater facilities for teaching the professional subjects should enable these larger institutions to concentrate greater efforts upon this line of work and to enlarge their possibilities for conducting such courses more effectively.

Students who have successfully completed four years of the kind of academic training sketched above and have thus earned the title of "assistant consulting psychologist" should be eligible for minor positions in the four fields of applied psychology. For example, a person who specialized in the first group might act as administrator of mental tests in employment offices or

as psychological adviser in advertising departments, or he might become an assistant to an expert consulting psychologist in some commercial concern. A man with special preparation in law would be able to conduct tests or gather statistical material in institutions of correction or in connection with juvenile courts, or similar institutions. Those who had specialized in education would be prepared for minor administrative positions in small school systems and act at the same time as vocational guides. Similarly, those who majored in the last group will be able to fill minor positions in institutions for mental defectives, or to supplement the work of medical examiners in private practice or in public offices. It would seem advisable that those who plan to prepare themselves for the higher titles would first acquire several years of practical experience in such minor positions before taking up post-graduate courses.

Concerning the latter but few recommendations need be made here. In preparation for the title of "consulting psychologist" and the master's degree it would seem advisable to continue the specialization along the line of either the major or minor subject selected in the senior year, with further advanced work in theoretical and experimental psychology and a thesis on an original minor problem. This kind of preparation should make the successful candidate eligible for such independent positions in his particular line as involve greater originality, independence, and responsibility.

Finally, the title of "expert consulting psychologist" together with the degree of Ph. D., are to be conferred upon the successful completion of at least two years of additional graduate work in all the different branches of applied psychology, with further specialization along two particular lines, preferably those engaged in before. Original research of a major problem and the publication of the doctor's thesis are in line with the customary requirements of obtaining this academic honor. The successful candidate is eligible to the highest positions offered in the various fields of applied psychology, especially to those which involve original research and independence of action as well as those which consist mainly in college teaching of the most advanced courses in applied psychology.

It is needless to point out that a few of our higher institutions of learning are already giving this kind of advanced training in applied psychology. Their practical experience in this professional preparation of consulting psychologists should be of great value in the demarcation and standardization of a uniform plan of training; and we hope to induce especially the present directors of this kind of technical training to con-

tribute to this discussion such criticisms and suggestions as will be most helpful to the cause of applied psychology.

In conclusion we may briefly restate the main points of the proposed tentative plan for the technical professional training of consulting psychologists: it suggests in the first place a uniform undergraduate course of three years obtainable in most of the smaller colleges at present, to be followed in the senior year by a more specialized professional course at some larger university: in the second place, it proposes the conferring by the institutions a graduated series of titles, such as assistant consulting psychologist, consulting psychologist, and expert consulting psychologist, parallel with the three regular collegiate degrees; and lastly, it recommends a qualitative subdivision of the various fields of applied psychology for the sake of more intensive specialization and preparation, along such lines as commerce, law, education, mental hygiene, and others. It may be deemed advisable for the American Psychological Association to consider this question officially and to refer it either to a special committee or to one already concerned with similar topics.[1] The *Journal of Applied Psychology* will be ready to publish further communications or contributions to this subject; or, if desired, to conduct a symposium on the question at issue.

[1] Since this was written the author has learned that the appointment of a special committee was authorized by the American Psychological Association at its recent annual meeting in Pittsburgh.

PSYCHOPATHIC LABORATORY AT POLICE HEADQUARTERS, NEW YORK CITY

By Dr. E. I. Keller, Consulting Psychologist

In December, 1916, the Psychopathic Laboratory at Police Department in New York City was opened for the examination of certain prisoners. The whole laboratory force consisted of psychiatrists, neurologists, psychologists and social workers, in order that they might bring to bear on the same subject different points of view, thus demonstrating that science—psychology, medicine and sociology—can make valuable contributions in solving one of the social problems of the metropolis, problems heretofore entrusted only to the police and the courts. This group was not only to serve the city in the examination of prisoners, but to engage also in research work along the lines of psychology, sociology and medicine.

The plan was, first, to make an intensive mental and physical survey of arrests in a certain district of the metropolis; the one chosen being the First District, south of Fourteenth street, between Bowery and East River; and, secondly, to begin a study of recividists. There are certain prisoners brought daily to Police Headquarters, that the Rookies, the new police, may see them at the morning line-up and thus become familiar with the various types of arrests throughout the city.

By March 1917, the staff in the Psychopathic Laboratory consisted of 3 psychiatrists, 1 psychologist, 1 social worker, loaned by Dr. Davenport of Cold Spring Harbor, 1 Secretary with his assistant-stenographer and typist. For the past four or five months a medical man has been daily at the Laboratory at Police Headquarters, ready to answer any call that might come in from this First District from 7 A. M. to midnight. The whole staff, save one on night duty, are in the Laboratory during the day.

The line-up at Headquarters is held daily about 8:45 A. M. Two or three medical men sometimes visit prisoners in cells, watch them when finger prints are taken or before they appear on the line-up. They always note their conduct on the line-up and decide which ones showing certain abnormal tendencies need further mental and physical examination. These are sent

to the Psychopathic Laboratory about 9 A. M. They are then examined by neurologists, psychiatrists and psychologists who are all in attendance from 9 o'clock on.

This hour is most advantageous for examination, as the prisoners are examined before they go up for trial, by persons who are interested in each one as an individual, not primarily in their crimes; except as the result of their study finds its place in the developmental history given later. The disadvantage is the lack of time, for all prisoners must be examined in time to get them to court by noon or earlier, and many courts are situated in distant parts of the city.

The laboratory for the psychological examination is well equipped with all the necessary apparatus to test many types of adults. The Binet tests are of little service save in those rare cases which are mentally much below par—that is, in the range of imbecility or idiocy. The mass of the cases are above the age of puberty, when differentiation sets in, and they call for a wide knowledge of all standardized tests and a wide experience with all sorts and kinds of adolescents and adults to enable the psychologist to make a hasty examination of any real value. Two, and often three, psychological examinations were given while the psychiatrist and neurologist had one or two hours to get the detailed history of one or possibly two patients. In addition to the test returns, and to make the psychological examination possible of interpretation, a certain amount of personal history had to be taken so as to cross-cut as often as possible the mental life of the subject in order to tell where the probable weak points were that called for further examination. Emotional reactions especially had to be watched, and the attitude and manner of the prisoner both to the examiner and to his work while under examination, had to be noted. Time also was required to get the prisoner into a normal state of mind that he might do his best. Always some written work was obtained to verify the school history, which of course was given only by the prisoner and was in nearly all cases very unreliable. It was necessary for the psychologist to have at immediate control the essential subjects of the common grades that a prisoner declared he had reached. He would declare, for example, that he had passed the 8th grade but be unable to read or cipher like a first year pupil. This might be indicative of poor memory or of the deteriorating effect of some nervous disease, like epilepsy, or, if both of these were eliminated, it probably denoted a tendency to prevarication. The written returns from tests proved later, at staff meetings, more valuable

for diagnosis than any mere account of his school history or life given by the prisoner himself.

After the physical and mental examinations were over, and prisoners were sent to court for trial, the staff meeting was called and cases examined were brought up for consideration. Each prisoner's personal, family and school history were read, the account of the crime as the arresting officer gave it as well as the account of his own arrest given by the prisoner himself and the returns of psychological examinations, as interpreted by the psychologist, were reviewed. Each one present was asked to comment on the case and a provisional diagnosis was made.

Often, however, it was necessary to send letters to the judge when the prisoner left even before staff meeting could be called. The director obtained a hasty report from psychiatrist or psychologist and formulated a letter on cases when prisoner was so obviously insane or so feeble-minded that the court would accept the diagnosis and a hospital or a school would be suggested as the haven of the prisoner instead of a penal institution.

A study of the 502 cases coming to the Psychopathic Laboratory from the day it opened in December 1916 to May 1, 1917, was made by the director, who offers the following classification based on determined diagnosis:

46 Insanity
82 Mental Defects
    Mental Defects 35
    Subnormal 4
    Moron 36
    Imbecile 7
3 Epilepsy
5 Psychoneurosis
8 Sex Perversions
66 Drug Habituations
38 Alcoholism
2 Abnormal Character
20 Emotional Instability
43 Psychopathic Characters
28 Asocial Characters
77 Unclassified
84 Not obviously abnormal

Of the 46 insane all were recommended to Bellevue Hospital for observation, in the hope that further commitment would be to the State Hospital for the Insane. Of the 82 with

decided mental defects only the lowest group (7) were recommended for institutional care, this leaves 75 of low mentality not recommended for commitment. The hurried examinations often forbade any regular, complete physical examination on the part of the physician. To a psychologist it was very interesting to note how significant the mental side of the problem was as against the physical. Even when there were marked stigmata of degeneration, the mental side of the picture in its lack or deterioration was more significant than any physical condition, and the medical men, as well as the psychologist stressed this in diagnosis. The interpretation of the personal and family history and the test returns of psychological examinations called for mental insight, and one was led to feel that all one's training and experience in psychology as well as in psychiatry were called constantly into service, to get at the underlying causes of the prisoner's difficulties. Glance over the classification made by the medical director, and leaving out the obviously insane and mentally defective, consider such terms as abnormal character, emotional instability, psychopathic character asocial character, in order to realize what a large part psychology takes in these divisions of the problem. Then consider how complex each individual is and how, even bringing long experience and training in mental problems to bear, we but scraped the surface of the life of those who fell under the head of psychoneurosis and sex perversion, drug-habituation, alcoholism, etc. These are mere symptoms, not syndromes. Some of us, versed and interested in psycho-analysis, felt that, as Dr. W. A. White suggested, these drug and alcohol cases have sought "a flight from reality" in alcohol and drug and would prove fine material to support or refute the theory of psycho-analysis, could they have been held for further examination. We desired a place at Bellevue Hospital for all these doubtful cases that they might be held under observation for further examination before even a diagnosis could be given, or any plan for re-education suggested.

When one realizes the chronological age of these so-called adult prisoners he sees the great need of getting at the causes that lie back of their delinquency. Of the first 200 cases sent to the laboratory, all male, the mode was 17 years and the average age or median was 21 years—150 falling between 16 and 24 years. In 502 cases of arrest, note that only 84 cases are not obviously abnormal. To the hard-headed taxpayer of moderate intelligence it must be clear that to have laws and conditions such that adolescent boys become

recidivists and are educated into crime, at an awful cost to the community, is absurd and wasteful, nay a crime of the law that allows it. To study the cases mentally and physically so as to educate aright, or to re-educate and then send many of them back to find their places in the community, will cost less than our present extravagant method of making them recidivists or repeaters in crime.

From the material gathered at police headquarters research can be done by medical, psychological and social workers. It is up to the individuals gathering this valuable data to interpret it for an intelligent public, to show the need for further work along these and related lines. This research work is individual and qualitative and calls for a genetic point of view—not group or quantitative and mechanical. Hope lies here for fine work for clinical and consulting psychologists, co-operating with psychiatrists and medical men.

With a biological and genetic point of view, scientists can thus discover where the youths have tripped or failed to develop and so suggest a possible cure, or better, some real preventive measures.

A NOTE ON MENTAL PECULIARITIES AS SYMPTOMS IN STUTTERING

By Walter B. Swift (Boston) and Jennie Hedrick (Washington, D. C.)

Can the subject under consideration be better expressed than by the query: In what way does the mental make-up of a stutterer differ from that of a non-stutterer? Are there mental symptoms which accompany the stutter? If so, what are they?

The object then will be to state a norm and compare the stutterer with it. We shall therefore begin with a definition of the norm, then give a description of several stutterers, and finally enumerate the points which conform to the norm and which do not.

In a normal brain all the brain areas are in a healthy condition so that they can function correctly. The intake through the sensory areas is duly interpreted, collaborated and sifted before passing through the motorium into speech. The result is shown in a well modulated, flexible speech over which the intellect rules.

With this norm before us, let us carefully scrutinize some of the stuttering cases treated for a month.

They can be separated into two distinct classes. One class has a high-strung shrinking nature. Their speech is hasty and uninhibited. Their thoughts are confused and dominated by the fear of stuttering. Their ever active minds demand expression. They resort to speed in utterance in order to sidetrack the stutter if possible. Though they fall, they are quickly up again. They may be called the optimists. They show an early quick onset of fatigue of their mental processes. The fear of stuttering is their worst enemy. They make the effort to speak, and then comes the unwelcome fear, with the accompanying break in the mental activities.

The members of the other class are phlegmatic. Apparently they have no thoughts waiting to be expressed. No fear of stuttering appears in their faces. They have learned to hide behind a closed countenance. They are the pessimists. They expect failure, so make no attempt to speak. This expectation dominates all their relations. They play games

which call for no speech. They read considerably. They refuse to answer in school, though they know their lessons. They are not interested in their fellow beings, are unsociable, taciturn and lonely.

The following are in the first class:

Case 1.—12 years old. Comes into the room and glances hastily around to see how she is to be received. Holds herself tense. Her thoughts are expressed in as few words as possible and in a quick, hasty manner. She is self-conscious, timid and repressed, she assents to all questions and is relieved when told "that is all."

Case 2.—10 years old. Rushes into the room with head foremost and breath exhausted; is eager to tell his thoughts, but is immediately tripped by the stutter. His mind, as well as his body, is active. He tries to perform his exercises before his mind has grasped the instructions. He shows an active mind uninhibited and easily fatigued.

Case 3.—Age 24. Although quick in thought and actions, he is confident that no one can cure his stutter. It is his most precious possession and he is loath to part with it. His mind is clear and active. He says that he seldom speaks in the words in which he thinks. Three or more words rush into his mind at the same time. The result is "confusion worse confounded," as his face testifies. In vain he tries to utter the chosen word and finally, when a word is pronounced, the idea which he has tried to express has vanished. One can easily understand how this inability to express his thoughts has caused him to select an occupation which requires no talking. To his credit be it said that he hopefully looks forward to a professional career.

The phlegmatic type is depicted in the following cases:

Case 4.—Age 10. A good mentality which is repressed. He avoids plays which call for speech, does not recite in school nor talk much at home. He has learned to keep silent pretty much all of the time.

Case 5.—Age 10. Enters the room with an indifferent expression. He is non-observant, unsociable and taciturn. Speech is not spontaneous but has to be coaxed. Apparently he considers his trouble incurable and submits meekly. Shows no marked effort to be rid of it.

Case 6.—Age 20. His trouble is ever with him. His answers are monosyllables or short sentences. He expects little and is not ambitious. Another hopeless stutterer.

Case 7.—Age 14. Has a quiet manner. Is dazed when asked to think. When told to do one of two things finds it difficult to make a choice. Answers "yes" or "no" to all questions. Would rather be scolded than attempt an explanation. Says very little and even that has to be drawn from him.

Case 8.—Reticent. Answers in short sentences, sensitive and sometimes dull.

Case 9.—Age 25. Has a slow, measured gait. Thinks slowly and speaks slowly. All his movements are carefully watched so that there may be no undue speed. His answers are short.

Case 10.—Age 5. Shy and silent. Takes her trouble seriously and allows it to overshadow her mentality.

In brief, the peculiarities found in these ten cases are:

Brevity—short answers and short sentences
Sensitiveness
Self-consciousness
Self-repression
Undue speed in speech
Uninhibited speech
Confusion of thoughts
Early and quick onset of fatigue in mental processes
Unsociability
Taciturnity
Despondency
Reticence

Summary of Findings.—We must conclude that stuttering forces the patient to do or perform numerous peculiar things which are wanting in normal people. These can properly be classed as symptoms of stuttering; they are surely performances that find their origin in the malady. Then, too, they disappear from the life as soon as the trouble vanishes.

BOOK REVIEWS

ROBERT S. CARROLL. *The Mastery of Nervousness Based Upon Self Reeducation.* The Macmillan Company, New York, 1917, p. 346.

Modern civilized life with its complexity and intensity is held responsible for the many cases of nervous debility which are now common to all classes of people. According to the author present conditions are more and more frequently presenting the individual with the question "Shall I lower my standards, shall I surrender in whole or in part; or shall I select wisely and train for mastery?" He believes that the latter decision is possible for the majority of serious-minded men and women and makes the purpose of the book to show how this end may be accomplished. The ground is taken that the possession of a nervous temperament under proper control means high capacity for work and enjoyment, whereas, if disordered or uncontrolled, it means keen capacity for suffering. Nervousness as viewed by the author is not due to any physical condition of the nerves but "represents a high capacity for response to external and internal stimuli with lack of selective and inhibitory control."

The main part of the book deals with the different types of nervousness including the motor, hypersensitive, suggestible, hypochondriac, neurasthenic, self-centered and repressed nervous; with their causes, among which are discussed the effects of heredity, faulty diet and dietary habits, insufficient exercise and play, defective thinking based on ignorance and false notions, weak wills, uncontrolled emotions and wrong moral attitude; and finally with the methods for correcting the physical, mental and moral disorders which are responsible for the condition of nervous debility.

The treatment of the hereditary causes of nervousness is made to include a much broader field than that which would be accepted by the modern geneticist in that the author includes such deranged conditions as are transmitted from parent to offspring through body poisons and disease germs as well as through the germ plasm. This point of view, however, does not affect the practical value of the book. From a biological standpoint the rest of the work is accurate and thorough. It is written in simple, untechnical language and in a most interesting style so that it will appeal to the layman for whom the book is especially designed. The advice given is based on sound hygienic principles and should be helpful in bringing many sufferers of nervousness back to health.

I. A. FIELD.

H. L. HOLLINGWORTH AND A. T. POFFENBERGER. *Applied Psychology.* D. Appleton and Company, New York, 1917, p. 337.

This work is intended to serve, on the one hand, "as a general text of applied psychology, presenting its principal aims, types, methods, its various fields of endeavor, and its outstanding results and accomplishments," and on the other hand, to fill "the need for an exposition of the subject which should be comprehensive, suggestive, and interesting without sacrifice of definiteness, accuracy and balance." In this attempt the authors have been eminently successful, and they have rendered a great and lasting service to the student, the teacher, the general reader, as well as to applied psychology itself.

In the first half of the book the subject is treated from the standpoint of "the personality and competence of the individual, regardless of his or her particular occupational activity." The first chapter deals with the definition, scope, history, difficulties, and limitations of applied psychology. It owes its rapid recent progress, according to the authors, to the fact that psychologists have become more interested in the outward signs of mental life, the behavior of the individual, and that "consciousness has become an aid to the understanding of behavior, instead of the reverse." Behavior itself is said to depend upon the integrity of the physiological mechanism, heredity, education, and the present stimulus or appeal to action. These four factors are made the basic topics of the subsequent eight chapters. The second and third chapters deal with the influence of heredity upon achievement and with family inheritance. The fourth chapter discusses under the heading of efficiency and learning the nature of the learning process, the relation of efficiency to habit formation, to acquisition of skill and to memory, and the effects of practice on individual differences. To the reviewer this chapter seems to be logically out of place and should follow naturally after the discussion of the environmental conditions. In the fifth chapter the influence of sex and age on efficiency are discussed. Here several distorting errors occur, the charts on pages 93 and 95 are interchanged, and on page 96 the table showing the averages obtained at the age of eighteen with eight mental traits is not sufficiently well explained and seems also to contain one or two typographical errors. The next two chapters consider the influence upon efficiency of such factors as ventilation, especially temperature and humidity, climate and season of the year, weather, daily rhythm, illumination, distractions, monotony, and solitude. The problems of work, fatigue, rest, sleep, and optimum duration of work periods are well summarised in the eighth chapter, and the ninth chapter in a similarly poignant way enumerates the physical and mental effects of tobacco, alcohol, coffee, tea, strychnine, and other drugs.

In the second half of the text "the attitude, content and technique of psychology are considered in their particular relevance to the various types and fields of occupational activity." The tenth chapter tries to justify this threefold division of utilising psychology. The characteristic psychological attitude is said to be one of analysis of mental complexes, which is being applied to the analysis of human behavior. The application of psychological knowledge consists in the direct use of scientific facts of mental life in the attempts to make human behavior more efficient, while the application of psychological technique consists in the employment of psychological apparatus of precision, test-material, methods of procedure, control of conditions, use of control subjects, elimination of sources of error, and the mathematical and statistical methods of gathering and computing data and results. Of the three divisions the first seems to the reviewer the most superficial and questionable, and the whole *principium divisionis* seems rather artificial and of little intrinsic value to the subsequent discussion. If this principle is of such importance for the second half of the book, why is it not equally applicable to the topics of the first half? The seven occupational activities treated in chapters eleven to seventeen are executive management, industrial work, commerce, law, social uplift work, medicine, and education.

From the point of view of the executive or employer the services

of applied psychology are needed in the vocational selection of employees, in the problems of individualisation and management, in the analysis, simplification, and standardisation of work and tools, in devising programs, records, schedules, means of reward, recognition and merit, and in the provision of sanitary conditions for work, opportunities for recreation, and pleasant home-environments. The point of view of the worker (chapter twelve) considers his mental set, the effective distribution of his efforts and organisation of his movements, the possibilities of time and motion studies, and the psychological effects of such methods on the worker. The psychology of business is only briefly outlined with reference to the consumer, the advertiser, and the salesman. A much more suggestive treatment is given to four aspects of legal psychology, those concerning the acumulation of evidence, the evaluation of testimony, the determination of responsibility, and the adaptation of corrective measures. In dealing with the psychology for the social worker, the mental causes of misery, the existence, diagnosis, and consequences of mental deficiency and abnormality, and the significance of the frequency distribution of mental traits are emphasised. In discussing the relations of psychology to medicine the following statement is made: "It may be said at once that in so far as medicine has profited from its utilization of psychology, this profit has been mainly by way of methodology and technique. In so far as there has been any interchange of content, psychology has been far more blessed in its receiving than in its giving. Medical clinics and medical practices have been drawn on freely for data, problems, suggestions and illustrations, and psychology still shows, in many quarters, pronounced anatomical, physiological and clinical bearings" (p. 286). Whether one is willing to agree with this statement or not, he will find it difficult to either prove or disprove it, and as it stands it is not apt to improve the inter-relations between the two disciplines. The applications of psychology to education are likewise discussed under the three-fold division, and it is pointed out that in all three instances education has derived great benefits from psychology, both in theory and practice. A short concluding chapter deals with the future of applied psychology and the means of making its results more readily available to the problems of practical life.

While the authors in the first chapter emphasise that the field of applied psychology is "to be every situation in which human behavior is involved and where economy of human energy is of practical importance," they forthwith omit to mention the many other topics which such a broad statement might include, and are thus apt to give the general reader a wrong idea of the complete scope of applied psychology. From the teacher's point of view the value of the book would be still further increased by the addition of bibliographical references at the end of each chapter. Considering the fact that the present volume is rather of a pioneer character, being the first comprehensive text on applied psychology, the authors have aimed at and attained a high standard of excellence, both in the presentation of their subject-matter and in the scientific conservatism and sound judgment displayed in their critical estimates of recent experimental studies. No student of applied psychology should fail to read this valuable text.

L. R. G.

HENRY F. ADAMS. *Advertising and its Mental Laws.* The Macmillan Company, New York, 1916, p. 333.

Advertising as it is typically exemplified in the popular weekly and monthly periodicals of large circulation is here considered from "the behavioristic standpoint." Other kinds of advertising are given only scanty attention, chiefly in the introductory chapters. The preface states that "this book is intended for students of the psychology of advertising though much of the material which is contained in it will undoubtedly be of benefit to the man who is in the practical side of advertising." Three chief aims are stated: First, "to present in simple language the basic facts and principles of psychology which are related to advertising and to point out the application of the principles." Secondly, "to reduce the complexity of a printed advertisement to its elements and to show with mathematical exactness the effect of the various elements." Thirdly, to point out the close agreement betwen the results of laboratory experiments and "the results of advertising campaigns in which similar problems have been involved."

The book begins with an introductory section of about 70 pages devoted to a general consideration of the nature and problems of advertising under the chapter headings; I. Definitions and Functions of Advertising; II. Advertising and Psychology; III. Advertising as a part of the Environment; IV. The Different Kinds of Mediums; V. Informing the Customer; VI. Experiments in Advertising. Following this is a short chapter, VII. Statistical Methods, in which the ordinary terms and procedure employed in the interpretation of statistical material are explained. The next seven chapters, constituting the bulk of the book, give an exposition of the psychology of attention, memory, etc., with a discussion of related problems in advertising. The laboratory methods which have been devised in connection with the psychological study of advertising are here fully explained and illustrated. Much original work by the author is included here, along with many results which have been published before. The chapter headings in this section are; VIII. Attention; IX. Holding the attention; X. Association; XI. Fusions; XII. Memory; XIII. The Appearance of Advertisements; XIV. Action; XV. Sex Differences, A short final chapter, XVI. Results obtained in Advertising closes the book.

As a whole, the main purposes of the book as set forth in the preface have been achieved. In regard to the mathematical exactness with which the effects of different factors in isolation have been determined, in "an endeavor to put the Psychology of Advertising on a quantitative basis, a strictly scientific basis," there is undoubtedly room for disagreement as to whether in many cases, *what is measured* can be stated with equal exactitude. It is also doubtful whether the form frequently used in stating results illustrated on p. 114—"The attention value of frequency of repetition varies approximately as the 1.12 root of the number of presentations"—conveys to the average reader any exact idea of the quantitative relation involved.

There is much constructive criticism of laboratory investigations relating to advertising, and possibly the reader will find the greatest contribution of the book to the literature of the subject in the sections where the experimental procedure and results are discussed.

The method of approach to the problems of advertising which is employed here will probably appeal more strongly to the undergraduate

student than to the practical advertiser. In certain chapters there is a complexity of structure which is baffling to the reader who attempts to keep track of the relations of the various subdivisions. For example, there is on p. 87 a division designated by I, followed by a subdivision 1; three pages later we find another set of sub-divisions 1, 2 and 3, followed by a section A in which there are again sub-sections 1, 2 and 3: sections B, C, D and E follow, with sub-sections; then on p. 106 appear sub-divisions 2 and 3 followed by 4, 5, 6 and 7, and on p. 116 we find what may be division II, and on p. 120 what may be division III, though the numerals are lacking. Other chapters, notably XII and XVI show a similar complexity, with a misprint on p. 327, where the section should obviously be numbered 2, instead of 1. The graphical presentation of experimental results, which is freely used to good advantage throughout the book would in many instances be of greater value if the quantities whose magnitudes are plotted were clearly indicated, and the unit of measure specified.

There are in the book, numerous statements, which obviously would have to be modified if they were critically examined. As a rule however, they are not such as to affect the main conclusions. We may note: p. 156. "By contiguity and succession are meant recall owing to simultaneous or successive entrance into consciousness of two ideas," as typical example.

C. E. MELVILLE.

J. ADDINGTON BRUCE. *Handicaps of Childhood.* Dodd, Mead and Company, New York, 1917, p. 310.

This book is written "to demonstrate the importance of early training in the moral sphere." It has the following nine chapters: mental backwardness, the only child, the child who sulks, jealousy, selfishness, bashfulness and indecision, stammering, fairy tales that handicap, and night terrors.

The author warns that "many children have been erroneously pronounced feeble-minded when their backwardness is in reality due to remediable causes." Of the *only child* he says some things of practical interest, but the evidence he cites to indicate tremendous handicaps of the only child may not convince all his readers. Sulkiness is often traceable to indigestion, malnutrition, adenoids, bad teeth, eye strain; but it is due "in nine cases out of ten to home environment." Likewise home training is responsible for exaggerated jealousy in children The "bashful man is the victim of subconscious memories of distressing incidents of his early life; incidents which in his case have had the effect of arousing in an exaggerated degree sentiments of shame or fear." Indecision in adults likewise have their setting in early childhood. "Stammering * * * is not at bottom an anatomical or physiological trouble * * * it is a mental malady, symptomatic of a psychoneurosis having its origin in subconscious emotional states." It is curable by such mental means as suggestion and "specific recall and eradication of the 'forgotten memories' that underlie it." The parents' place is to "guard the young from needless emotional stress of early training, to foster in children, calmness, courage, self-confidence." Fairy tales are responsible for most of the fears and night terrors of childhood, and for like phenomena in adults. Dream analysis is called in as evidence.

With the general advice which Mr. Bruce gives to parents, most readers doubtless will agree. With his contention, however, tha

home training is the chief cause of the several handicaps some will disagree. Numerous statements, such as the following, will hardly meet with universal approval: "in most cases the child who is a true dullard may be brought almost if not fully, to normal intellectual activity provided he is taken in hand at an early day" (p. 8); "Today scientists largely hold that not more than one or two per cent. of criminals can be stigmatised as criminals by birth; that insanity is not inheritable like eye color or hair color; and that nervousness is, at bottom, an acquired, rather than inherited, disorder" (p. 156); "the three principal causes of mental disease are excessive indulgence in alcohol, sexual indiscretions, and emotional distress" (p. 157).

In the hands of the uncritical lay readers, to many of whom Mr. Bruce is doubtless better known than are most eminent American scientists, such assertions are of doubtful value.

Brooklyn Training School for Teachers. GARRY C. MYERS.

IRVING R. ALLEN. *Personal Efficiency, Applied Salesmanship, and Sales Administration.* LaSalle Extension University, Chicago, 1917, p. 315.

In the first part the author discusses four problems of salesmanship. He begins by making the distinction between the direct purchase of some concrete article and the indirect offer of personal service. The successful salesman must apply both methods, that is, he must be able to sell his own services to the prospective employer, and the goods he deals in to the prospective customer. The next step is to impress favorably with the high quality of one's physical and mental equipment. The former includes personal appearance and health, the latter may be summarised by the terms personality and effort. Personality includes all unintentional influences due to self-confidence, fearlessness, ambition, will-power, concentration of attention, and sincerity. Intentional effort relates to cultivating a good memory for names and faces, effective speech, suggestion, tact, interest, initiative, and reliability. This section of the book contains many valuable hints to the student of applied psychology. The third problem deals with locating and securing the right position and winning promotion, that is, with the methods of buying and selling personality or service, while the fourth problem is concerned with the analysis and stages of selling goods.

The second part discusses sales administration under the following divisions: the product and its distribution, sound selling policies, the successful sales manager, bases of compensation for salesmen, controlling men in the field, the sales manager's records, hiring the new salesman training salesmen, and high-speed helps. Throughout the text each problem is well illustrated from practical business experiences, and there are many useful hints and suggestions as to how to meet similar situations. At the end of each main division there are a number of well stated and selected questions which are intended to help the reader apply the lesson of the text to his own particular circumstances and to analyse and observe the concrete situations with which he may be confronted. In this respect the present volume is perhaps one of the most useful texts among the many books of its kind that have recently appeared.

GREENVILLE KLEISER. *Fifteen Thousand Useful Phrases.* Funk and Wagnalls Company, New York, 1917, p. 453.

In his Introduction to this collection of pertinent expressions, striking similes, useful, significant and impressive phrases, literary, commercial, conversational and oratorical terms and synonyms, Frank H. Vizetelly gives a short account of the present day tendency among English speaking and writing people to overwork certain words and phrases, and he points out the need of reviving phrase-books which two centuries ago were considered valuable supplements to dictionaries and other language guides. Such an attempt at revival has been made by the author of this collection, which is intended as an aid in building up a large vocabulary and in developing clearness, accuracy, and diversity in oral and written expression. He submits a concrete plan of study of the contents for the busy man. The book contains eleven divisions; useful phrases, significant phrases, felicitous phrases, impressive phrases, prepositional phrases, business phrases, literary expressions, striking similes, conversational phrases, public speaking phrases, and miscellaneous phrases. In each division the phrases are arranged in alphabetical order.

There are no indications either as to the sources from which this material is taken, or as to the contexts in which it should or should not be used. Aside from the questionable merit of many phrases, it seems that a fruitful perusal of the book would pre-suppose rather than help to develop a delicate sense for good style and a keen appreciation of appropriate words and phrases.

HARRINGTON EMERSON. *The Twelve Principles of Efficiency.* (Fifth Edition). Industrial Management Library, The Engineering Magazine Company, New York, 1917, pp. xviii, 423.

In his short introduction to this work Charles Buxton Going poignantly says that it "reduces the doctrine of efficiency to a code upon which to base rules of practice." Five of the twelve principles concern the relations between employer and employee, the others deal with methods or institutions and systems occurring in manufacturing concerns. The workings of each principle are explained by the help of many positive and negative illustrations well chosen from actual practices and malpractices. It is impossible to more than indicate each principle briefly: 1. clearly defined ideals promulgated throughout the plant, 2. "supernal common sense" and sound judgment, 3. competent counsel wherever found, 4. the spirit of discipline and reverence for law and order, 5. the fair deal, based upon the exclusion of the many unfit and the selection of the fit, 6. reliable immediate, and accurate records, 7. planning ahead and despatching according to schedule, 8, standards and schedules, 9. standardised conditions of adjustment, 10. standardised operations, 11. written standard-practice instruction, and 12. efficiency reward.

The one critical suggestion that forces itself upon the reader of the many anecdotal illustrations is that there were fewer of them and that instead some space were devoted to practical hints or explanations as to the general application of the twelve principles to the concrete problems of modern industrial life. This is perhaps asking too much, and the next best thing is what the author of this volume has attempted to do, to reduce the complicated mechanism of industrial management to a few guiding principles and to illuminate their operation from as many angles as possible.

The following books and pamphlets have been received: [1]

MAXIMILIAN P. E. GROSZMANN. *The Exceptional Child.* Charles Scribner's Sons, 1917, pp. 764.

HORACE SECRIST. *An Introduction to Statistical Methods.* The MacMillan Company, New York, 1917, pp. 482.

WALTER S. ATHEARN. *Religious Education and American Democracy.* The Pilgrim Press, Boston, 1917, pp. 394.

WILLIAM A. WHITE. *The Principles of Mental Hygiene.* The MacMillan Company, New York, 1917, pp. XV + 323.

OSIAS L. SCHWARZ. *General Types of Superior Men.* (With a Preface by Jack London and an Introductory Letter by Max Nordan). Richard G. Badger, Boston, 1916, pp. 435.

FRANK B. AND LILLIAN M. GILBRETH. *Measurement of the Human Factor in Industry.* Presented at the National Conference of the Western Efficiency Society, May 22-25, 1917. 14 p.

CARL C. BRIGHAM. *Two Studies in Mental Tests.* 1. Variable Factors in the Binet Tests. 2. The Diagnostic Value of Some Mental Tests. *Psychol. Monographs,* Vol. 24, No. 1, 1917. 254 p.

TRUMAN LEE KELLEY. *Mental Aspects of Delinquency.* University of Texas Bulletin, March, 1917. 125 p.

THOMAS H. HAINES. *The Increasing Cost of Crime in Ohio.* Bull. No. 4 of the Bureau of Juvenile Research, June, 1916. 10 p.

RUDOLF PINTNER. *A Mental Survey of the School Population of a Village.* Reprinted from *School and Society,* Vol. 5, No. 125, May 19, 1917.

—— ——. *The Mentality of the Dependent Child, Together with a Plan for a Mental Survey of an Institution.* Reprinted from the *Journal of Educational Psychology,* April, 1917.

—— —— and HERBERT A. TOOPS. *A Chart for Rapid Computation of Point Scale Scores.* Reprinted from the *Journal of Delinquency,* Vol. 2, No. 4, July, 1917.

THOMAS H. HAINES. *Two Pairs of Young Repeaters.* Reprinted from the *Journal of Delinquency,* Vol. 1, No. 4, Sept., 1916.

—— ——. *Notes on Mental Conditions of Adult Female Offenders in Ohio.* Reprinted from the *Journal of Delinquency,* Vol. 2, No. 2, March, 1917.

—— ——. *The Genesis of a Paranoic State.* Reprinted from the *Journal of Abnormal Psychology,* Feb.-March, 1917.

FREDERICK ADAMS WOODS. *Significant Evidence for Mental Heredity.* Reprinted from the *Journal of Heredity,* Vol. 8, No. 3, March, 1917.

RUSSELL L. GOULD. *Manual Accuracy in Prevocational-School Boys.* Reprinted from the *Journal of Educational Psychology,* Sept., 1917.

J. E. WALLACE WALLIN. *The Individual Tests in the Binet-Simon Scale.* Reprinted from the *Psychological Clinic,* Vol. 11, No. 3, May 15, 1917.

A. A. ROBACK. *The Psychology of Confession.* Reprinted from *The University Magazine,* April, 1917.

LILLEN J. MARTIN. *Personality as Revealed by the Content of Images.* Reprinted from *Science, N. S.,* Vol. 45, No. 1165, April 27, 1917.

[1] Mention here does not preclude further comment.

GEORGE ELLIS JONES. *Hygiene and War.* (With an Introduction by William Henry Burnham). Edited by Paul Monroe and published by the Carnegie Endowment for International Peace, Division of Intercourse and Education. Publication No. 11. Washington, D. C., 1917, pp. 207.

GRACE L. MEIGS. *Infant Welfare Work in War Time.* Reprinted from the *American Journal of Diseases of Children,* Aug., 1917, Vol. 14, pp. 80-97.

WILLIAM H. BURNHAM. *Mental Health for Normal Children.* Massachusetts Society for Mental Hygiene, Boston, 1917, pp. 8.

L. W. CRAFTS. *Bibliography of Feeble-Mindedness in its Social Aspects.* Reprinted from *Journal of Psycho-Asthenics Monograph Supplement,* Vol. 1, No. 3, 1917, pp. 73.

HOMER T. SMITH. *Letters, A Brief Course in Business-Letter Writing.* Milwaukee, Wisconsin, 1916, pp. 24.

A. LEILA MARTIN. *A Contribution to the Standardization of the De Sanctis Tests.* Reprinted from the *Training School Bulletin,* No. 14, Vineland, N. J., September, 1916, pp. 18.

HENRY H. GODDARD. *Eugenics from the Professional Standpoint.* Reprinted from the *Journal of the Medical Society of New Jersey,* 1917, pp. 12.

—— ——. *The Vineland Experience with Pincal Gland Extract.* Reprinted from the *Journal of the American Medical Association,* May 5, 1917, Vol. 68, pp. 1340 and 1341.

—— ——. *The Menace of Mental Deficiency from the Standpoint of Heredity.* Reprinted from the *Boston Medical and Surgical Journal,* Vol. 175, No. 8, Aug. 24, 1916, pp. 269-271.

—— ——. *Alcholism and Feeble-Mindedness.* Reprinted from the *Interstate Medical Journal,* Vol. 23, No. 6, 1916, pp. 4.

HUGO MÜNSTERBERG

The following communication has been received:

SIR:—

The American Journal of Applied Psychology, June, 1917, p. 186-7 contains a translation of a letter to Professor William Stern of Breslau from Professor Hugo Münsterberg, which is published in the Feitschrift für Pedagogische Psychologie und experimental Pedagogik Jan.-Feb., 1917. The letter contains the following:—"Day and night I work before and behind the scenes in the interest of the political struggle, and fortunately thus I can accomplish much. Of course almost all of my old relations are severed, especially here in Boston. Most of my friends here no longer recognize me; I have been thrown out of clubs and out of Academies. All their rage has concentrated upon me but we hold out. . . . It is our plan to take the first Hamburg steamer, etc."

Professor Münsterberg belonged to only two American Academies —The American Academy of Arts and Sciences, Boston, and the Washington Academy, Washington, D. C.

I was president of the American Academy of Arts and Sciences when Professor Münsterberg, of his own volition, offered his resignation. It was accepted in dignified silence. The corresponding Secretary of the Washington Academy, Mr. Robert B. Sooman, writes that "Professor Münsterberg voluntarily presented his resignation to that Academy."

JOHN TROWBRIDGE.

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Monthly (10 numbers). Psychology and training of defectives.

Journal of Race Development—Worcester, Mass.: Louis N. Wilson.
Subscription $3. 460 pages annually. Founded 1910. Quarterly.
Edited by George H. Blakeslee and G. Stanley Hall.

Journal of Educational Psychology—Baltimore: Warwick & York.
Subscription $3. 600 pages annually. Founded 1910.
Monthly (10 numbers). Managing Editor, J. Carleton Bell.
(Educational Psychology Monographs. Edited by Guy M. Whipple.
Published separately at varying prices. Same publishers.)

Journal of Animal Behavior—Cambridge, Mass.: Emerson Hall.
Subscription $5. 450 pages annually. Founded 1911.
Bi-monthly. Robert M. Yerkes, Managing Editor.

The Behavior Monographs—Cambridge, Mass.: Emerson Hall.
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Quarterly. Founded 1913. Ed. by W. A. White and S. E. Jelliffe.

Journal of Experimental Psychology—Princeton, N. J.: Psychological Review Company. 480 pages annually. Experimental. Founded 1916.
Subscription $3.25 Bi-monthly. Edited by John B. Watson.

Journal of Applied Psychology—Worcester, Mass.: Florence Chandler.
Subscription $4. 400 pages annually. Quarterly. Founded 1917.
Edited by G. Stanley Hall, John Wallace Baird and L. R. Geissler.

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